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LIGHT ARMORED VEHICLE (LAV) TASK AND MEDIA ANALYSIS FOR  
THE US MARINE CORPS LAV-25(U) BAUM CHEMICAL CORP CARSON  
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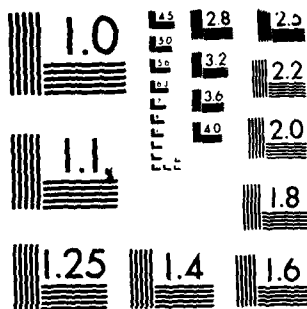
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Light Armored Vehicle, LAV-25, Task and Media Analysis		5. TYPE OF REPORT & PERIOD COVERED Final Report, Phase I 27 April - 26 August 1983
		6. PERFORMING ORG. REPORT NUMBER C731.08
7. AUTHOR(s) C. Fagan                      J.B. Cuddeback              R.F. Zumbado J.L. Maxey                      P.H.L. Brown		8. CONTRACT OR GRANT NUMBER(s) N61339-82-D-0004
9. PERFORMING ORGANIZATION NAME AND ADDRESS Eagle Technology, Inc. 3165 McCrory Place, Suite 235 Orlando, FL 32803		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Commandant of the Marine Corps (TDG-40) Headquarters, U.S. Marine Corps Washington, D.C. 20380		12. REPORT DATE 26 August 1983
		13. NUMBER OF PAGES 257
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Naval Training Equipment Center Orlando, FL 32813		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for Public Release; Distribution Unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Task List, Task List Validation, Hands-On Training Tasks, Task Selection Criteria, Entry Level Skills Analysis, Hands-on Training Requirements Analysis		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The overall objective of this project is to provide the Marine Corps with recommendations on training devices which can be used to train turret operation/gunnery skills and associated operator maintenance training on the Light Armored Vehicle (LAV-25). This project is designed to be carried out in two phases, the first a Task and Media Analysis and the second, a Training Equipment Survey. This report presents the procedures and results of the first phase. (continued on back)		

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20. ABSTRACT - continued

The Task and Media Analysis begins with an analysis and documentation of all tasks required to operate the LAV-25 turret and perform associated operator maintenance. Then, through an investigative process using Government provided documentation, U.S. Marine Corps and U.S. Army subject matter experts (SMEs), LAV-25 manufacturer documentation and SMEs, tasks which required hands-on training were determined.

The essential products of this Task and Media Analysis Report are as follows:

- o A complete, validated task list for all LAV turret systems operations and operator tasks organized into groupings of related tasks;
- o A list of tasks which require training;
- o A list of tasks which require hands-on training (HOT),
- o A list of training media alternatives for groups of related HOT tasks.

These products will be used in Phase II, the Training Equipment Survey, to guide the selection and recommendation of training devices.

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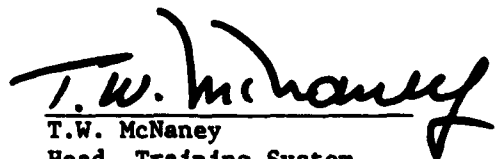
Naval Training Equipment Center  
Orlando, FL 32813

**LIGHT ARMORED VEHICLE (LAV)  
TASK AND MEDIA ANALYSIS  
FOR THE  
U.S. MARINE CORPS LAV-25**

**26 AUGUST 1983**



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## ACKNOWLEDGEMENTS

This Task and Media Analysis, sponsored by the Commandant of the Marine Corps (CMC), was conducted under contract to the Naval Training Equipment Center (NTEC) during the period May to August 1983. The effort was conducted initially under the direction of Mr. William A. Duncan of the Land Analysis and Design Branch, NTEC (N-253). On the occasion of his reassignment, project directorship was assumed by Dr. David J. Daly, NTEC (N-253).

The authors are indebted to the above individuals and to the various Subject Matter Experts and command representatives from Headquarters, U.S. Marine Corps, Washington, DC; Marine Corps Air Ground Combat Center, Twentynine Palms, CA; Infantry Training School, Camp Pendleton, CA; and the U.S. Army Infantry School, Fort Benning, GA, for their significant contributions and outstanding cooperation throughout all phases of this analysis. These noteworthy individuals are specifically listed in Table 2-6, Section 2 of this report.

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## SECTION 1

### INTRODUCTION

#### 1.1 Purpose

In May 1983, the Naval Training Equipment Center (NTEC) contracted with Eagle Technology, Inc., to conduct a Training Device Requirements Analysis for the U.S. Marine Corps Light Armored Vehicle. The objective of this effort was to provide the Marine Corps with recommendations for a training device (or combination of training devices) to instruct turret operation/gunnery skills and associated operator maintenance tasks on the Light Armored Vehicle (LAV). This study was designed to be carried out in two phases, the first a Task and Media Analysis and the second, a Training Equipment Survey. The critical steps for each phase are shown in Figure 1-1. This report presents the procedures and results of the first phase. The results of the second phase, the Training Equipment Survey, will be presented in October 1983.

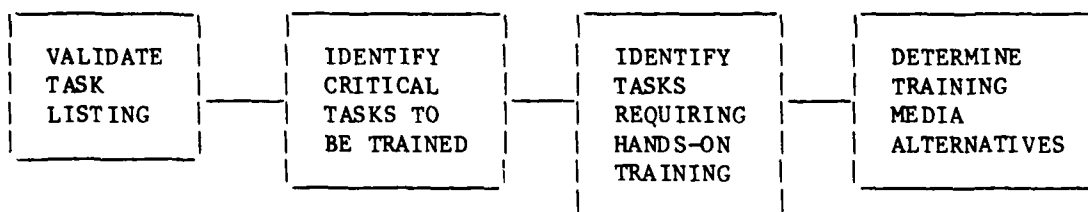
The Task and Media Analysis began with the documentation and analysis of all tasks required to operate the LAV-25 turret and perform associated operator maintenance. Then, using what was essentially a filtering process, tasks which required hands-on training were determined. The fidelity requirements of these tasks were then analyzed to derive training media alternatives.

The essential products of the LAV-25 Task and Media Analysis were:

- A complete, validated task list for all LAV turret system operations and operator maintenance tasks organized into groupings of related tasks.
- A list of tasks which require training.
- A list of tasks which require hands-on training (HOT).
- A list of training media alternatives for groups of related HOT tasks.

These products will be used in Phase II to guide the selection and recommendation of training devices.

PHASE I - TASK AND MEDIA ANALYSIS



PHASE II - TRAINING DEVICE SURVEY

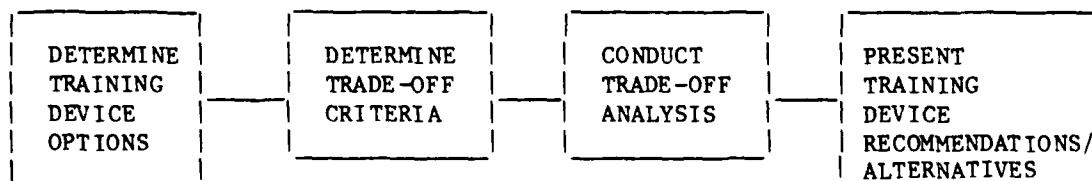


Figure 1-1. Phases I and II, LAV-25 Study.



## 1.2 Background

In its amphibious force role, the Marine Corps has a continuing responsibility to improve both its tactical maneuverability and increase its firepower in the objective area. The advent of the Rapid Deployment Force (RDF) and the substantive Marine Corps role in the RDF spotlighted, at the Congressional level, the need for accelerated improvement in the areas of maneuverability and firepower. Consequently, with the impetus of Congressional activity, the LAV program was designed to compress the weapon system acquisition cycle through procurement of essentially off-the-shelf LAVs.

The LAV-25 is an eight-wheeled combat vehicle designed for a nine man squad of Marines. The squad is organized into a three man crew and a six man assault team with the squad leader assuming the role of vehicle commander. The vehicle's armament includes the M242 25mm automatic cannon, the M240 7.62mm coaxial machine gun and the M257 smoke grenade launcher. The vehicle's gross weight when fully loaded is 14.5 tons making it transportable by heavy lift helicopter or cargo aircraft. The LAV-25 is 251.7 inches long, 98.4 inches wide and 106 inches high. It can travel 60 mph on paved roads and can swim at 6.5 mph. The LAV-25 is manufactured by General Motors (GM) of Canada.

The LAV program is a joint U.S. Army and U.S. Marine Corps program formally established in June 1981. It is structured to give the Marine Corps the lead in testing and developing the vehicle under the direction of the Marine Corps LAV Program Manager (PM) located at the U.S. Army Task and Automotive Command (TACOM), Warren, Michigan.

In addition to the production contract for the LAV-25s, the Marine Corps has a research and development contract for procurement and testing of two each of five different mission role vehicles (MRVs) with options to buy varying quantities of the MRVs over the contract period. The five MRVs under development will be constructed on the same baseline vehicle as the LAV-25 and are identified as follows:

- LAV (AT) - Anti-tank
- LAV (R) - Maintenance and Recovery

- LAV (M) - 81mm Mortar
- LAV (L) - Logistics
- LAV (C<sup>2</sup>) - Command and Control

Two additional MRVs, LAV (AD) for air defense and LAV (AG) for an assault gun, are currently in planning.

Consistent with the accelerated nature of the LAV-25 acquisition, development of the Marine Corps training program has been commensurately accelerated. The training program will be designed to provide qualified personnel to staff the first LAV units in the immediate future and establish the training pipeline over the long term for all LAV units.

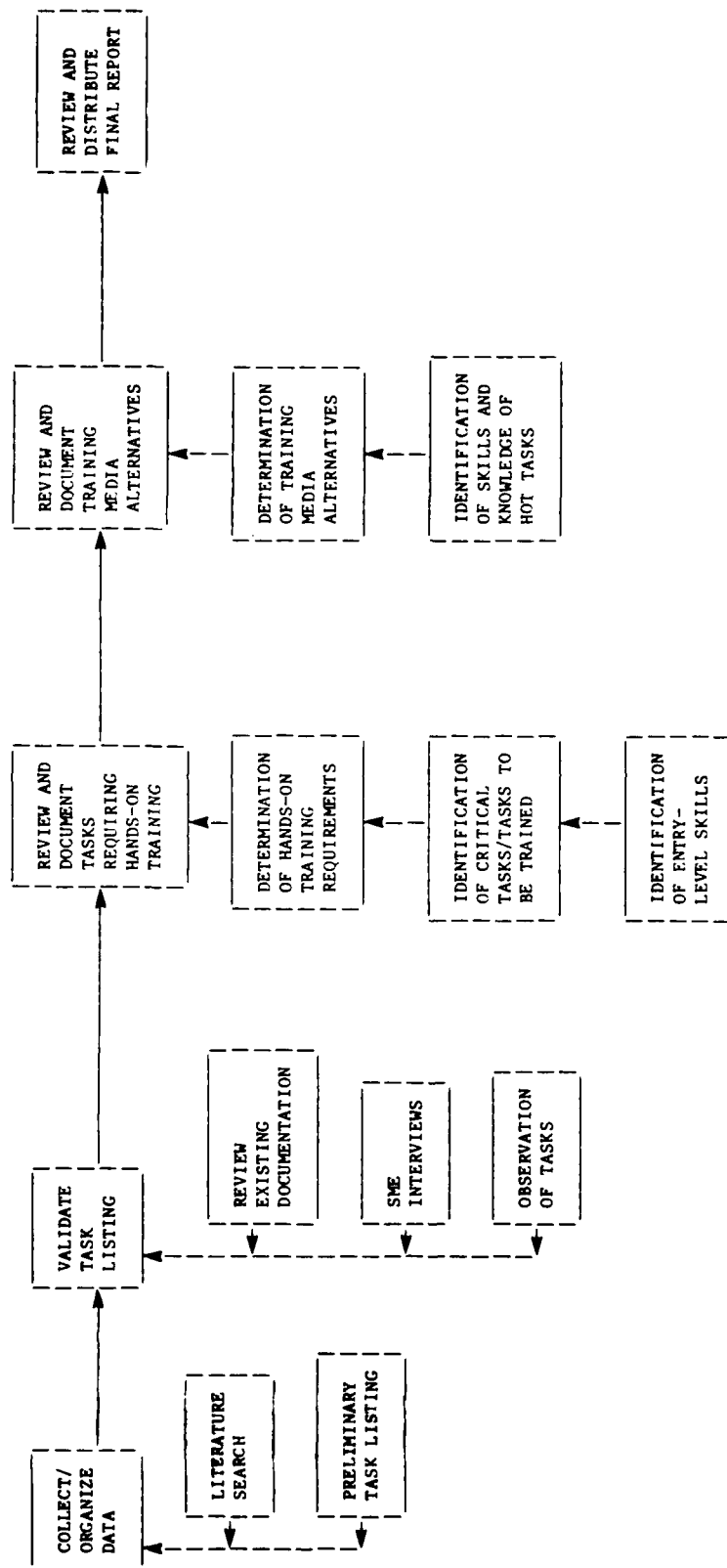
The current study will provide the Marine Corps with recommendations for training devices in a timely manner based on a systematic analysis of available data. In addition, the data collected during this analysis will contribute significantly to any subsequent acquisition of training devices.

### 1.3 Scope

The LAV-25 Task and Media Analysis was completed using a five step process generally conforming to the guidelines suggested by the Interservice Procedures for Instructional Systems Development (IPISD). The five steps were:

- Collect/Organize Data
- Validate Task Listing
- Determine Hands-On Training (HOT) Requirements
- Determine Training Media Alternatives
- Document Procedures and Results

The sub-steps of each of these five steps are shown in Figure 1-2. An overview of these steps and sub-steps is provided in the remainder of this section.



**Figure 1-2. LAV-25 Task and Media Analysis Process**

1.3.1 Collect/Organize Data. This step comprised a literature search and development of a preliminary task listing. Using various U.S. Army and Marine Corps institutions, the Defense Technical Information Center (DTIC) and the Manpower and Training Research Information System (MATRIS) as sources, the literature search yielded relevant background and content data for LAV-similar training. Concurrent with the literature search, a preliminary task listing was developed by incorporating literature search data with other Government and LAV contractor-provided documentation.

1.3.2 Validate Task Listing. Development of appropriate military training and identification of suitable training devices depend on accurate, detailed, and complete definition of the tasks which must be performed to accomplish the job to be trained. Concentrating on tasks involving LAV-25 weapon systems, turret operation, and operator level maintenance, the task list was validated and refined by E-Tech personnel through an iterative process. Initial validation was performed by attending the 40 hour turret operation course provided by GM of Canada at Meadford Range, Ontario, for the Marine Corps. Participation in the course included observation and performance of LAV-25 tasks by E-Tech personnel. Further validation was conducted through two working sessions with Marine Corps subject matter experts (SMEs) for 10 days in Orlando, Florida, and 2 days at Aberdeen Proving Grounds, Maryland. Throughout this process, additional validation was conducted by independent review of draft task lists by Marine Corps personnel at Infantry Training School (ITS), Camp Pendleton, California, and Company A, First LAV Battalion, Twentynine Palms, California.

1.3.3 Determine Hands-On Training (HOT) Requirements. HOT tasks are those which because of the task to be learned, require the use of operational equipment or training devices for efficient learning to occur. Concurrent with the task list validation process and with the aid of Government and contractor (GM) provided LAV documentation, as well as SME inputs and E-Tech personnel expertise, all HOT tasks in the task list were identified.

1.3.4 Determine Training Media Alternatives. The validated task list with the segregation of HOT tasks relevant to each of the training levels (institution and unit) is the basis for determining appropriate training media alternatives. This determination was made through application of a three step process. In the first step, the specific skills and knowledge required to perform each HOT task, its subtasks and step have been identified. Secondly, using identified skills and knowledge for each task, the physical properties of stimulus materials and media attributes of prospective training equipment were determined. The third step accomplished was to develop a list of all possible training media alternatives which meet the functional and physical fidelity characteristics of training equipment necessary to train all HOT tasks within groups of related tasks.

1.3.5 Document Procedures and Results. The documentation of procedures for and results of the Task and Media Analysis constitutes the remainder of this report and its appendices.

#### 1.4 Report Organization

This report is organized into three sections. Section I, the present section, discusses the LAV project and provides an overview of the Task and Media Analysis. Section II describes in detail the methodology for the Media Analysis. Finally, Section III discusses results of the Media Analysis. Additionally, appendices are provided which include the final validated task list, task list reference sources and tasks requiring hands-on training.

## SECTION 2

### METHODOLOGY

#### 2.1 Introduction

Section II provides information concerning the process and approaches that were undertaken in the performance of the following steps:

- Literature Search
- Task List
- Tasks Requiring Hands-On Training
- Training Media Alternatives

The methodology involved with each of the steps is described in the following paragraphs. Results and documentation of the above steps are described in Section III.

#### 2.2 Literature Search

As a first step in performing the LAV-25 Task and Media Analysis, a literature search was conducted to identify, obtain, and review documents and materials related to turret operations and gunnery skills training to include LAV type weapons, contractor training materials, manuals, and training effectiveness studies. The literature search was conducted in the following four phases:

- Manpower and Training Research Information System (MATRIS), Work Unit Search
- Defense Technical Information Center (DTIC), Work unit Search
- DTIC Technical Report Search
- Personal Contacts

These phases are discussed in detail below to include the specific methodologies and procedures employed in their conduct.

2.2.1 MATRIS Work Unit Search. The MATRIS collects, stores, updates and retrieves information on people-related research sponsored by the Department of Defense (DoD) (65). It is used to identify current research rather than to retrieve research reports. This system has a flexible retrieval capability to provide researchers and managers with individual summaries describing the purpose, approach, progress, dates of initiation and termination, work unit leader, and performing organization for all work units falling within a selected topic area. An example of a MATRIS work unit summary is provided in Appendix A.

In February 1983, a MATRIS search was requested. This involved, first, contacting a MATRIS representative via telephone and making a verbal request for the search. Next, a letter documenting the search need was prepared and sent to the MATRIS office in San Diego, California, to confirm the telephone request. The research requested was for the topic area GUNNERY TRAINERS and GUNNERS.

Subtopic areas specified included:

- Air Combat Training - Gunnery
- Air Defense Training - Gunnery
- Gunfire Simulation
- Gunnery Trainers
- Helicopter Machine Gunner Training
- Tank Training - Gunnery
- Gunners - Machine Gun and Tank

It was to be limited to work unit descriptions that were unclassified and not older than 10 years.

On 1 March 1983, the requested search was conducted. It yielded a total of 45 summaries reflecting either current or recent work for the U.S. Air Force Human Resources Laboratory (3 summaries), the U.S. Army Research Institute (30 summaries), and the U.S. Naval Training Equipment Center (7 summaries). Following receipt of the search, each work unit description was reviewed to determine its relevancy to the LAV Task and Media Analysis

objectives. This involved examining the summaries to identify those that addressed either armor training, gunnery skills, and/or training devices and other media selection. This examination resulted in identification of 11 U.S. Army Research Institute summaries reflecting ongoing projects or work units completed/terminated since 1978 and two completed Naval Training Equipment Center efforts (see Table 2-1).

Principal investigators for the work units listed in Table 2-1 were contacted concerning the current status of their projects and the availability of research products, e.g., technical reports, training materials, findings and/or implications. In the case of the Army Research Institute, Mr. Don Kistiansen, Dr. David Bessmer and Dr. Truman Tremble were contacted. Their work units were discussed at length and recommended research literature was identified to be ordered from the Defense Technical Information Center (DTIC). Also, Mr. William Osborne, Director of the Human Resource Research Organization (HUMRO), Fort Knox office, was contacted to discuss HUMRO's armor-related work (items 9, 10, and 11 in Table 2-1). He too made recommendations for literature to be ordered from DTIC. Finally, the Marketing Manager for International Laser Systems, Mr. Haro Schneider, was contacted to discuss the Air-to-Air Laser Gunnery projects performed for the Naval Training Equipment Center. He provided current descriptions of the Laser Air-to-Air Gunnery Simulator (LATAGS) including photographs of the system.

Thus, as a consequence of the information provided by the MATRIS search, it was very easy to identify key players in current armor and gunnery research, make contact with these individuals to obtain report titles and numbers and discuss their accomplishments to date. These discussions included a synopsis of the LAV Task and Media Analysis and solicitation of data that might prove useful in or be relevant to successful accomplishment of project objectives.

**2.2.2 DTIC Work Unit Search.** The DTIC is a component of the DoD scientific and technical information program. It provides access to and transfer of scientific and technical information for DoD personnel, DoD contractors, and other U.S. Government agency personnel and their



TABLE 2-1. MATRIS IDENTIFIED WORK UNITS RELATED TO LAV TASK AND MEDIA ANALYSIS

WORK UNIT TITLE	SERVICE	RESPONSIBLE ORGANIZATION	PRINCIPAL INVESTIGATOR	START DATE	STATUS <sup>1</sup>	RELEVANCE TO LAV PROJECT
1. Identification of Test Doctrine for Cost-Effective Qualification of Tank Crews	U.S. Army	Army Research Institute	G. Wheaton, American Institutes for Research	November 1975	Completed, March 4, 1978	Investigating integration of specific simulation techniques into a gunnery proficiency evaluation.
2. Research on Methods of Evaluating Tank Platoon Gunnery	U.S. Army	Army Research Institute	G. Wheaton, American Institutes for Research	August 1978	Completed, May 1981	Studying development of procedures and criteria for evaluating crew and unit gunnery performance.
3. Developing Techniques for XH1 Training Devices	U.S. Army	Army Research Institute	D. Bessmer, Army Research Institute	October 1980	Terminated, September 1981	Using training devices to compare effectiveness of alternative training approaches.
4. Simulation Characteristics for Armor Systems	U.S. Army	Army Research Institute	D. Bessmer, Army Research Institute	October 1977	Completed, September 1979	Determining simulation technology required for armor training.
5. Tank Gunnery Training Devices Mixes	U.S. Army	Army Research Institute	D. Bessmer, Army Research Institute	October 1981	Continuing	Assessing applicability of computer graphic and video disk technology to support gunnery training.
6. Gunnery Training Components for the XH1 Tank	U.S. Army	Army Research Institute	D. Kristiansen, Army Research Institute	October 1979	Terminated, September 1980	Developing training concept and prototype materials to bridge gap between individual and collective skills.
7. Validation of Armor Crew Sustainment Gunnery Training Program	U.S. Army	Army Research Institute	T. Tremble, Army Research Institute	October 1977	Terminated	Evaluating simulation-based gunnery training program.
8. Evaluation of Tank Gunnery Training Devices for Unit Environment	U.S. Army	Army Research Institute	T. Tremble, Army Research Institute	October 1979	Terminated	Validating gunnery training devices.
9. Mission-Based Simulation and Training Requirements	U.S. Army	Army Research Institute	E. Drucker, Human Resources Research Organization	January 1980	Completed, January 1980	Completing development of battle drills.
10. Implementation of Part-Task Tank Gunnery Trainers	U.S. Army	Army Research Institute	W. Melching, Human Resources Research Organization	September 1981	Completed, November 1982	Designing training program for part-task gunnery training devices.

TABLE 2-1. MATRIX IDENTIFIED WORK UNITS RELATED TO LAV TASK AND MEDIA ANALYSIS  
(continued)

WORK UNIT TITLE	SERVICE	RESPONSIBLE ORGANIZATION	PRINCIPAL INVESTIGATOR	START DATE	STATUS <sup>1</sup>	RELEVANCE TO LAV PROJECT
11. Tank Systems Skills and Training Structure	U.S. Army	Army Research Institute	W. Osborn, Human Resources Research Organization	April 1976	Completed, December 1979	Developing prototype gunnery skills training for individual and unit skills.
12. Air-to-Air Gunnery Simulator	U.S. Navy	Naval Training Equipment Center	W. Merrel, International Laser Systems, Inc.	September 1977	Completed, January 1979	Developing laser-based training device for machine gun.
13. Air-to-Air Laser Gunnery Services Support	U.S. Navy	Naval Training Equipment Center	H. Towle, University of Central Florida	September 1979	Completed, June 1980	Developing laser-based training device for machine gun.

<sup>1</sup>Status was as indicated by the work unit summary.

contractors. As one of its major functions, DTIC maintains the Research and Technology Work Unit Information System (WUIS), which contains research project descriptions at the work unit level that have been or are currently being performed by DoD and NASA, or under DoD contract.

As a check on and supplement to the MATRIS search, a WUIS search was initiated. This search was requested via an Information Request (DTIC Form 4, JAN 81) which was sent to the DTIC offices at Cameron Station, Alexandria, Virginia. In making this request, a broad coverage search was specified, covering the last ten years in the area of TRAINING DEVICES. In conducting the WUIS search, DTIC personnel employed a two tier strategy.

The first tier (or level) topic area terms selected for the search were:

- Armored Personnel Carriers
- Armored Vehicles
- Gun Turrets
- LAV
- Light Armored Vehicles
- Tank Turrets
- Tanks (Combat Vehicles)

The second tier search items selected were:

- Gunnery Trainers
- Training Devices
- Training Films
- Training Gear

Finally, all work unit citations having a CONFIDENTIAL or SECRET classification were excluded from consideration in conducting the search. This was judged to be a reasonable exclusion since the interest of the search was to identify any "mainstream" work units missed by the previously conducted MATRIS search.

The WUIS search yielded a total of 27 items partitioned among the services as follows:

- U.S. Army, 21 citations
- U.S. Air Force, 2 citations
- U.S. Navy (including U.S. Marine Corps), 4 citations

An example WUIS summary is provided in Appendix A.

An initial screening of the work unit summaries was conducted to eliminate items that were obviously unrelated to the LAV Task and Media Analysis or were too out-of-date to be relevant to the project. This eliminated all but five work unit summaries. These are described in Table 2-2.

In reviewing these work units and comparing them to the MATRIS work units listed in Table 2-1, it is immediately apparent that items 1, 3, and 5 from Table 2-2 are identical to items 8, 5, and 4, respectively, from Table 2-1. This probably reflects a degree of overlap between the DTIC and MATRIS work unit data bases. Additionally, it provides confirmation that the search strategies employed to examine the two separate data bases were adequate to select items relevant to the LAV project as these were defined by the terms which formed the basis for the searches.

With respect to the remaining items in Table 2-2 (i.e., items 2 and 4), upon discussion with Dr. Dave Bessmer, item 2 was found to have undergone a change of direction, and the specific topic of interest (the use of various visual media such as slides, computer graphics, and video tape to support testing of procedural skills) was no longer an area of interest in the work unit. With respect to item 4, this was determined to have evolved into the Tank Weapons Gunnery Simulation System (TWGSS) which is in the Research and Development stage and scheduled for fielding in the FY86-88 timeframe by PM TRADE. (76)

Generally, the DTIC work unit search did not generate any new relevant work units. Only one new item was identified, the TWGSS. Three relevant summaries for the DTIC search were found to duplicate summaries previously

TABLE 2-2. DTIC IDENTIFIED WORK UNITS RELATED TO THE LAV TASK AND MEDIA ANALYSIS

WORK UNIT TITLE	SERVICE	RESPONSIBLE ORGANIZATION	PRINCIPAL INVESTIGATOR	START DATE	1		RELEVANCE TO LAV PROJECT
					STATUS		
1. Evaluation of Tank Gunnery Training Device for Unit Environment	U.S. Army	Army Research Institute	T. Tremble, Army Research Institute	October 79	Terminated		Validating gunnery training devices
2. Training Techniques for M1 Driving	U.S. Army	Army Research Institute	D. Bessmer, Army Research Institute	October 81	Continuing		Evaluating use of visual media (slides, computer graphics, video tape) to support gunnery training
3. Tank Gunnery Training Devices Mixes	U.S. Army	Army Research Institute	D. Bessmer, Army Research Institute	October 81	Terminated		Assessing applicability of computer graphics and video disk technology to support gunnery training
4. Tank Appended Crew Evaluation Device	U.S. Army	DARCOM Field Office PM TRADE	A. Kendall, PM TRADE	April 77	Completed Jun 79		Developing appended device to assess individual and collective crew armor skills
5. Simulation Characteristics for Armor Systems	U.S. Army	Army Research Institute	D. Bessmer, Army Research Institute	October 77	Completed		Determining simulation technology required for armor training

1 Status was as indicated by the work unit summary.

identified by the MATRIS search. The balance of the summaries identified by the search were either irrelevant or too old; or had been overcome by events.

2.2.3 DTIC Technical Report Search. In addition to maintaining the WUIS, the DTIC maintains a collection of over 1 million technical reports which are accessible through a computerized bibliographic system and an additional 300,000 documents available for manual searching. All technical reports entered into the computerized bibliographic system have been coded via a number of specific descriptors or key words, e.g., Armor Training, Gunners, training, transfer of training. As a consequence, bibliographic searches of the technical report data base are easily accomplished and are performed on a no cost basis for DoD registered users.

Given the availability of the bibliographic search through DTIC, the LAV project staff initiated searches immediately after contract award for the following areas:

- Armor Crew Training
- Armored Vehicle Training
- Gunnery Training Devices
- Transfer of Training

These searches were requested over the telephone to the DTIC Demand Services Branch at Cameron Station, Alexandria, Virginia. In requesting the searches, document citations that were CONFIDENTIAL or SECRET were to be excluded so as to tap just "mainstream" documents. Additionally, the searches were confined to the literature of the last 10 years. Table 2-3 summarizes the results of these searches, showing first and second level search terms and the number of citations identified. As shown in this table, a total of 688 potentially relevant citations were identified in these searches. However, in reviewing the items contained in each search, some duplication of citations was found to exist. As such, the total number of unique items identified by the searches was somewhat less than 688.

TABLE 2-3. SUMMARY OF DTIC GUNNERY AND TRAINING TECHNICAL REPORT SEARCH STRATEGIES

SUMMARY INFORMATION	ARMOR CREW TRAINING	ARMORED VEHICLE TRAINING	GUNNERY TRAINING DEVICES	TRANSFER OF TRAINING
1st Level Retrieval Terms	Artillery Units Crews Flight Crews Ground Crews Gun Crews	Adaptive Training Air Force Training Apprenticeship Army Training Computer Aided Instruction Individualized Training Industrial Training Job Training Leadership Training Management Training Marine Corps Training Military Training Naval Training Programmed Instruction Retraining Teaching Methods Training	Aerial Gunnery Anti-Aircraft Gunnery Artillery Fire Gunnery Gunnery Trainers Naval Gunnery	Transfer-of-Training
2nd Level Retrieval Terms	Anti-Aircraft Gun Combat Crew Served Weapons Self-Propelled Gun	Armored Personnel Carriers Armored Vehicles Combat Vehicles Self-Propelled guns Tanks (Combat Vehicles) Weapons Carriers	Gunnery Trainers Training Ammunition Training Devices	Aerial Gunners Armored Personnel Carriers Armored Vehicles Artillery Units Gunners Infantry Squad Level Organization Tank Crews Tanks (Combat Vehicles)
Citations Retrieved	251	139	252	46
Cumulative Citations Retrieved	251	390	642	688

Following receipt of the searches, they were reviewed by a LAV project staff member familiar with the Armor and Gunnery training literature. Because of the duplication among the searches and in the interest of reducing the review time for other LAV staff members, the results of the four searches were screened to eliminate duplications and irrelevant items.

In conducting the screening process, items from each of the bibliographic searches were first inspected to determine whether they were directly relevant to the project effort. An item was considered to be relevant if it addressed at least one of the following specific topics:

GUNNERY TRAINING

Aiming  
Tracking  
Bore Sighting  
Firing on the Move  
Night Firing  
Target Acquisition

TRAINING DEVICES

Gunnery Trainers  
Laser Trainers  
Training Aid for Gunnery

ARMOR TRAINING

Crew Drills  
Battle Runs  
Armor Training Plans

This examination yielded a considerable reduction in the number of items to be reviewed by other staff members. In particular, the reductions were:

- Armor Crew Training from 251 to 30 items (88 percent reduction)
- Armored Vehicle Training from 139 to 37 items (73 percent reduction)
- Gunnery Training Devices from 252 to 38 items (85 percent reduction)
- Transfer of Training from 46 to 14 items (69 percent reduction)

Next, the remaining items were sorted into one of the following categories:

- Armor Gunnery Training
- Armor Training Devices/Aids
- Non-Armor Training Devices/Aids

In sorting into these categories, duplicated items were identified and eliminated. This resulted in a relatively small set of items for review by the balance of the LAV project staff. There were 40 items to review for Armor



Gunnery Training; 69 items for Armor Training Devices; and 26 items for Non-Armor Training Devices.

Over a period of three days, the reduced set of bibliographic references were examined to identify specific reports that would likely benefit and support LAV project objectives. In selecting reports to order, priority was given to very recent reports, reports addressing the current state-of-the-art in training and simulation technology, and reports addressing gunnery training for the M2/M3 fighting vehicles and the M1 tank. Based on this staff review, a total of 42 documents were identified for ordering. Of these, 21 were categorized by DTIC as having an unlimited distribution and could be directly ordered by E-Tech from DTIC. The remaining 21 were categorized as limited distribution and had to be ordered by a Government representative.

Following identification of the desired documents, an E-Tech staff member ordered the unlimited distribution items over the telephone from the DTIC Demand Services Branch. These arrived at E-Tech within 10 days from the date of the order. Concurrent with ordering the unlimited distribution documents, a list of the desired limited distribution documents was prepared which specified the accession document (AD) numbers required for ordering. This list was provided to the project COTR so that he could order these documents through appropriate Government channels. A summary list (short titles and their AD numbers) of the documents obtained from DTIC from these searches is provided in Appendix B.

2.2.4 Personal Contacts. During a project or study effort, personal contacts usually represent a significant source of documentation. The LAV Task and Media Analysis was no exception to this rule. During the work effort, a wide variety of related materials were obtained from the following sources:

- Product Manager for Armor Devices, PM TRADE, Orlando, FL
- Mr. Hal Strassel, U.S. Army Research Institute, Fort Benning, GA, Field Unit
- U.S. Army Infantry School, Fort Benning, GA

- U.S. Marine Corps Liaison Office, Naval Training Equipment Center
- General Motors of Canada
- General Electric Company, Simulation and Control Systems Department, Daytona Beach, FL

The specific materials obtained from each of these sources are listed in Table 2-4. In general, these materials directly contributed to development of the task lists for the LAV and to an understanding of the issues involved in identifying appropriate media options for LAV operator training.

### 2.3 Task List

In order to accomplish the "Task Analysis" portion of this Task and Media Analysis, a systematic, iterative process was employed. Application of the process yielded a complete and validated list of tasks, Appendix C, required to perform all operation and operator level maintenance functions for the LAV-25 turret and armament systems. This process is graphically displayed in Figure 2-1 and discussed in the remainder of this section.

2.3.1 Collection of Documentation. In developing a preliminary task list, the LAV-25 turret/armament operation and operator maintenance tasks were reviewed. These documents were obtained from various Department of Defense, U.S. Marine Corps, U.S. Army and U.S. Navy sources as well as the LAV contractor, GM of Canada. A complete source listing of all documents used in the task analysis is presented in Appendix D. The method for collecting these documents is described in Section 2.2.

2.3.2 Preparation of Preliminary Task List. The preliminary task list was developed by thorough study, extraction and extrapolation of written and graphic data in documents obtained in the collection process previously described. Table 2-5 identifies the specific documents used to derive the preliminary LAV-25 task list.

TABLE 2-4. DOCUMENTATION OBTAINED THROUGH PERSONAL CONTACTS

PERSONAL CONTACT	DOCUMENT DESCRIPTION
Product Manager for Armor Devices (Mr. Bill Stansberry, Deputy PM)	Instructor Utilization Handbook for XM1 Unit-Conduct of Fire Trainer (U-COFT), Volume 2, Appendix A: Sections III-IV, 1 June 1981.  Instructor Utilization Handbook for XM1 Unit-Conduct of Fire Trainer (U-COFT), Volume 3, Appendix A: Section IV, 1 June 1981.  Instructor Utilization Handbook for XM1 Unit-Conduct of Fire Trainer (U-COFT), Volume 4, Appendix A: Section IV, 1 June 1981.  Appendix B, Training Exercises Unit - Conduct of Fire Trainer M1 U-COFT Device AL7B14, Volume I, 1 April 1981.  Appendix B, Training Exercises Unit - Conduct of Fire Trainer M1 U-COFT Device AL7B14, Volume II, 1 April 1981.  Appendix B, Training Exercises Unit - Conduct of Fire Trainer M1 U-COFT Device AL7B14, Volume III, 1 April 1981.  Task Descriptions of Mounted Crew Operations for the MICV/TBAT II (IFV), Volume I, August 1978.  Army LAV Skill Levels 1 and 2 Task List.  Tank Gunnery Devices, FM 17-27-7, June 1977.
Mr. Hal Stassel, U.S. Army Research Institute, Ft. Benning, GA  U.S. Army Infantry School, Ft. Benning, GA  U.S. Marine Corps Liaison Office, Naval Training Equipment Center  General Motors of Canada	Delco Systems Operations and General Motors Operations. LAV-25 (MC) Turret Operator's Handbook. (No Report #). Goleta, CA: Delco Systems Operations and General Motors Corporation, 3 June 1983.
General Electric Company, Simulation and Control Systems Development, Daytona Beach, FL	General Electric Company Conduct of Fire Trainer Orientation Briefing.

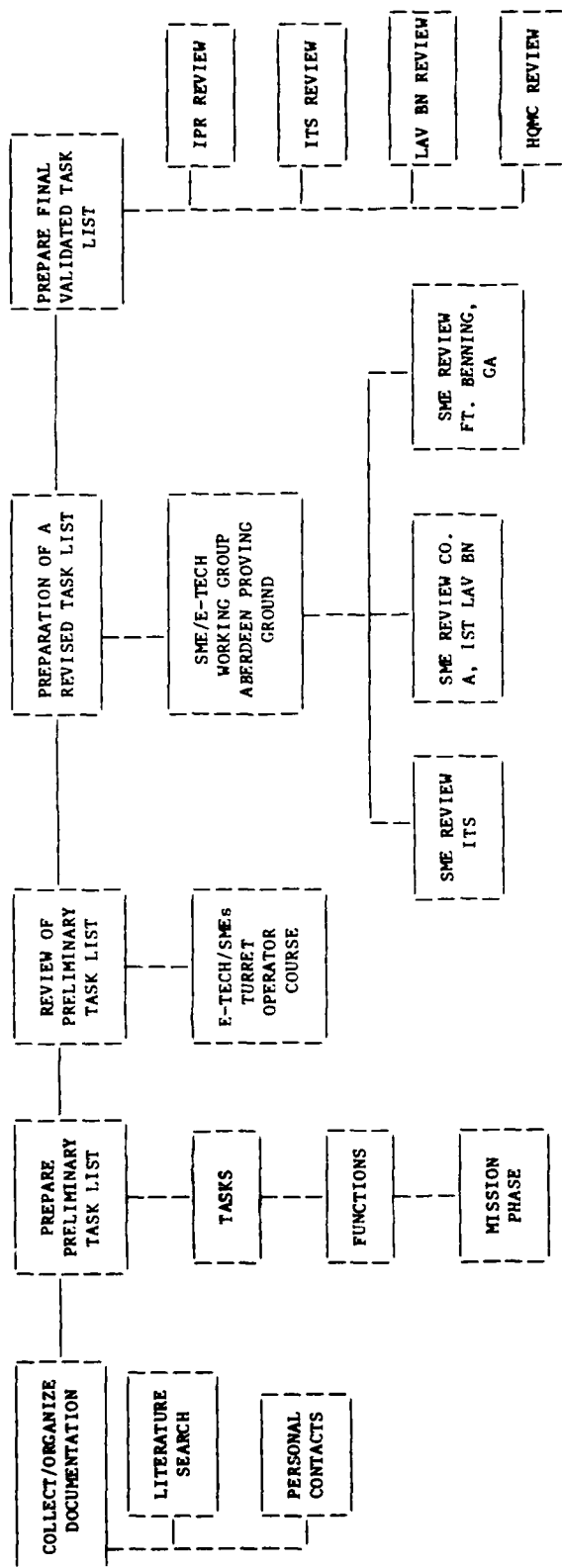


Figure 2-1. Task List Preparation and Validation Process.

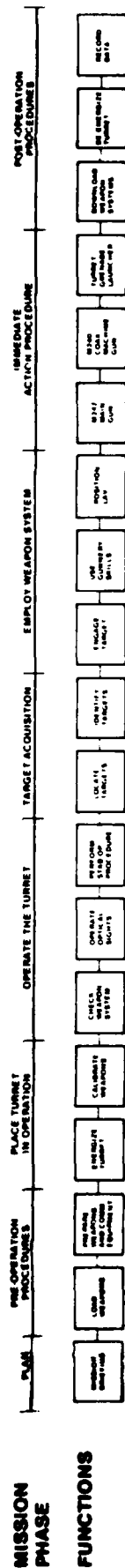
TABLE 2-5. DOCUMENTS USED FOR LAV-25 PRELIMINARY  
TASK LIST

1. LAV-25 (MC) Turret Operator's Handbook, Canadian Commercial Corporation, Delco System Operations, General Motors Corporation.
2. Task List for Turret and Weapon Stations, Headquarters, U.S. Marine Corps (TDG-40).
3. LAV-25 (MC) Turret Operator's Course, Instructional Materials by Canadian Commercial Corporation, Delco Operation's Division, General Motors Corporation.
4. LAV-25 (MC) Turret 2d-4th Echelon Maintenance, Instructional Materials by Canadian Commercial Corporation, Delco Electronics Division, General Motors Corporation.
5. Infantry and Cavalry Fighting Vehicle Gunnery FM-71-999A (Draft), U.S. Army Infantry and Armor Centers and Schools.
6. Tank Gunnery, FM-17-12, U.S. Army Armor School, Ft. Knox, KY.
7. Tank Gunnery Training, TC-17-12-5, U.S. Army Armor School, Ft. Knox, KY.
8. Analysis Branch SOP for the Review of Critical Tasks Selection for the LAV-25, U.S. Army Infantry School, Ft. Benning, GA.
9. Military Occupational Specialties (MOS) Manual, Marine Corps Order PI200.7D.

Systematic organization of the preliminary task list was accomplished by first categorizing candidate tasks as either operator or maintenance tasks. These two categories were further subdivided into mission phases which were in turn divided into functions. These categories are shown in Figure 2-2. It was anticipated that by grouping tasks within such a structure, gaps could be identified and relationships between tasks could be discovered.

2.3.3 Review of Preliminary Task List. The preliminary task list developed from the documentation in Table 2-5 was subjected to an initial review and validation process by E-Tech project team members at the 40 hour LAV-25 Turret Operator course conducted 16-20 May 1983, at Owen Sound

# OPERATOR



# OPERATOR MAINTENANCE

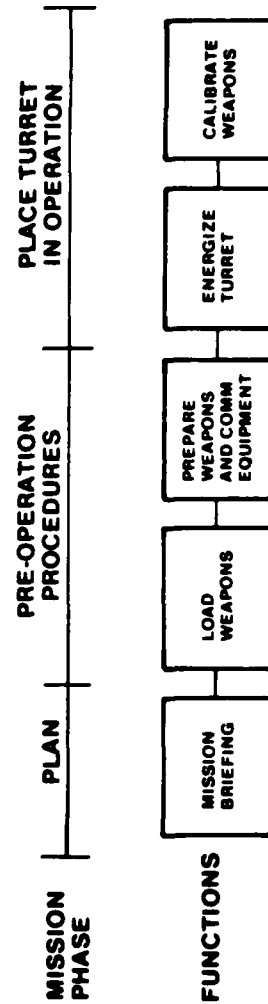


Figure 2-2. Categories of Operator and Operator Maintenance Tasks.

(Meadford Range), Ontario, Canada. The course was attended by Marine Corps Subject Matter Experts (SMEs), which included training development personnel and prospective LAV-25 instructors. The school afforded opportunities for Marine Corps SMEs and E-Tech personnel to perform and validate many tasks during periods of hands-on practice sessions on turret operations in the vehicle. Additionally, a spare M242 25mm Main Gun and an M240 7.62mm coaxial machine gun and associated feed chutes were available for use in validation of specific weapon-related tasks. The validation process was enhanced by the use and review of the latest GM draft publications and other relevant publications obtained during the collection of documentation. As a result, some subtasks and steps were identified as being out of sequence; some were added; and others were expanded upon. Often cautionary notes/warnings were developed and inserted between tasks where warranted by personnel safety considerations.

The course proved to be extremely fruitful for what it could not validate as well as for what it could. Marine Corps, GM and E-Tech personnel concluded that several task areas required further study to determine safety precautions/warnings, task expansion, task development and reordering. Therefore, additional reviews were scheduled to be conducted during June 1983.

2.3.4 Preparation of Revised Task List. Preparation of secondary task lists began when the data collected at the contractor LAV-25 Turret Operator's Course were incorporated into the preliminary list. The next task listing iteration was performed during an intensive and detailed review conducted at a joint working session of Marine Corps SMEs and E-Tech project personnel. This working session was conducted during the period 27 June to 8 July 1983, in Orlando, and spanned the In-Progress Review (IPR) of 29 June. Following the work session, the updated task list was forwarded for independent on-site reviews by Marine Corps SMEs at ITS, Camp Pendleton, the First LAV Battalion, Marine Corps Air Ground Combat Center (MCAGCC), Twentynine Palms, California and Army SMEs at Ft. Benning.

It must be understood at this point that although the LAV-25 is essentially an off-the-shelf buy, some equipment modifications and operating procedure dynamics were still occurring which impacted the task list. Some unanswered questions and unvalidated tasks remained upon conclusion of on-site

SME task list reviews. In order to resolve these issues, a final two day work session involving Marine Corps SMEs and E-Tech project personnel was conducted at Aberdeen Proving Grounds, Maryland, during the period of 2-3 August. The product of the foregoing effort was a revised secondary task list, essentially ready for final approval/validation.

Throughout each step of the work efforts discussed in paragraphs 2.3.3 and 2.3.4, various SMEs contributed invaluable expertise. A complete listing of SMEs is presented in Table 2-6.

2.3.5 Validation of the Task List. The final LAV-25 task list validation consisted of review and annotation by Marine Corps SMEs from Headquarters, U.S. Marine Corps, ITS Camp Pendleton and the First LAV BN, MCAGCC. This activity was conducted during the period of 9-11 August at the U.S. Army Tank and Automotive Command (TACOM), Warren, Michigan, concurrent with the 10 August IPR.

All changes resulting from the 9-11 August review are incorporated in the final validated LAV-25 task list, which is presented in Appendix C to this report.

## 2.4 Tasks Requiring Hands-On Training

This section describes the approach used to identify those tasks which require familiarization and/or practice on hardware for learning to occur. This approach involves using a filtering process based on the validated task listing. Entry-level skills are identified and compared with the validated task listing to yield tasks which require some form of training. Those tasks that require training are then cross-referenced with criteria for selecting hands-on training tasks. The following paragraphs describe the process.

2.4.1 Identification of Entry Level Skills. The purpose of identifying entry level skills prior to course entry is to compare them with the existing tasks involved with LAV operation and operator maintenance in order to determine which tasks need to be trained. Since we are looking at a training



TABLE 2-6. SUBJECT MATTER EXPERTS WHO PARTICIPATED  
IN LAV-25 TASK LIST DEVELOPMENT AND VALIDATION

MILITARY			
NAME	RANK/ SVC	ASSIGNMENT	ORGANIZATION
Powell, Alex	LtCol, USMC	Training Review Officer, LAV Acquisition Coordinating Group	Headquarters, U.S. Marine Corps, (TDG-40) Washington, D.C.
Pearson, W.H.	Major, USMC	Commanding Officer	Company A, First LAV Battalion, MCAGCC, Twentynine Palms, CA
Beeman, D.L.	Captain, USMC	Training Officer	ITS, Camp Pendleton, CA
Lytle, T.M.	Captain, USMC	OIC, LAV-25 Course	ITS, Camp Pendleton, CA
Barnes, David	1st Lt, USMC	Assist OIC, LAV-25 Course	ITS, Camp Pendleton, CA
Smithee, N.W.	Gy Sgt, USMC	Sr. Instructor, LAV-25 Course	ITS, Camp Pendleton, CA
Garner, D.C.	Gy Sgt, USMC	Sr. Instructor, LAV-25 Course	ITS, Camp Pendleton, CA
Sanchez, M.	Gy Sgt, USMC	Sr. Instructor, LAV-25 Course	ITS, Camp Pendleton, CA
Hunnicuttt, R.G.	Sgt, USMC	Instructor, LAV-25 Course	ITS, Camp Pendleton, CA
Hanes, D.E., Jr	MSG, USA	LAV-25 Project Staff	U.S. Army Infantry School, Ft. Benning, GA
Roberson, P.R.	SSG, USA	LAV-25 Project Staff	U.S. Army Infantry School, Ft. Benning, GA

system that will support both the Infantry Training School (ITS) and the Unit training, we are also looking at different entry level skills. A thorough understanding of both these ITS and Unit environments, the environment from which the student came (recruit training) in addition to the MOS structure and career paths, is necessary for the identification of skills and knowledge prior to any LAV course entry. This identification was reached by reviewing and analyzing the MOS structure and career paths, the recruit training curriculum, the ITS curriculum and the Unit curriculum.

2.4.1.1 MOS Structure and Career Paths. Review of Government provided information indicates that MOS structure, training and career paths of prospective LAV-25 personnel will be superimposed over the existing infantry occupational field (OF-03) pipeline. Two new OF-03 Military Occupational Specialty (MOS) designators have been established to identify assault team (MOS 0312) and vehicle crew personnel (MOS 0313). The primary input source into both MOSs will be the ITS. The assault team personnel will be so designated on the basis of the standard ITS basic infantry training curriculum. Graduates of the basic ITS selected for vehicle crew MOS 0313, will complete an additional six-week course at the school. The additional course will encompass driving, basic gunnery, turret operations and operator maintenance.

Another input source comes from Marine Corps policy which provides for transfers across MOSs as career and reenlistment incentives to Marines. Therefore, it is anticipated that a secondary source of up to ten percent of LAV-25 personnel will be lateral transfers. Since lateral transfers may occur at any point in a Marine's career, he may enter the LAV-25 field at the supervisory level (non-commissioned officer) with little or no LAV-25 background. Also, regardless of the early career path, MOS 0312 or MOS 0313 Marines may progress to the squad leader/vehicle commander level and higher. The projected career paths of these MOSs are depicted in Figure 2-3.

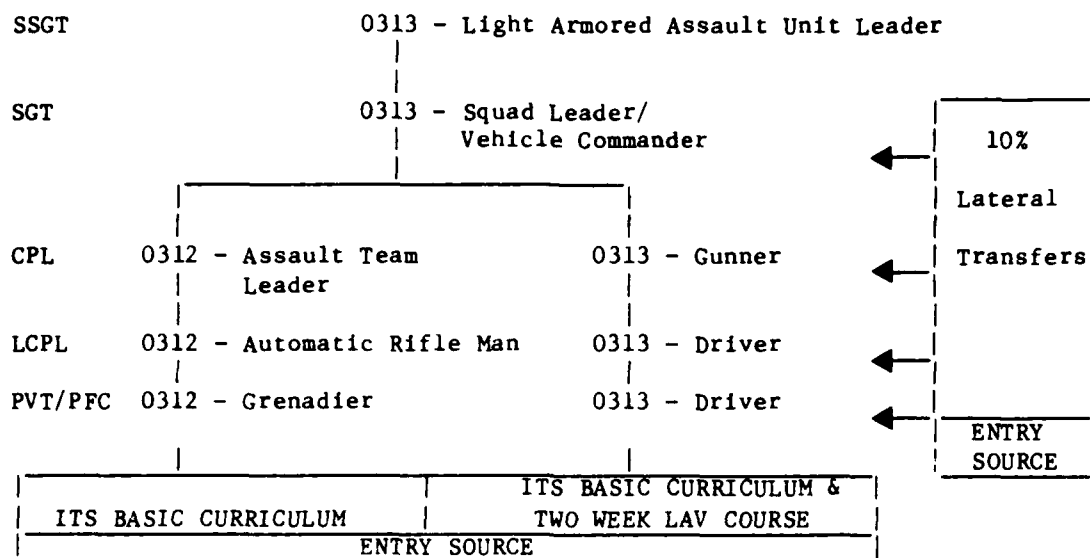


Figure 2-3 LAV-25 MOS Structure and Career Paths.

2.4.1.2 Recruit Training Curriculum. The information on the MOS structure and career paths provided the background knowledge against which to review documentation concerning Marine Corps recruit training curriculum data. The objective of this review was to identify specific LAV-25 applicable training, if any, received by Marines at the recruit level. In addition to recruit training information gained from interviews with Marine Corps SMEs, specific documents reviewed are shown in Table 2-7.

TABLE 2-7 RECRUIT TRAINING CURRICULUM DOCUMENTS

- Individual Training Standards (ITS) System; Volume I - Training Objectives for the Infantry Occupational Field (Occ Fld 03), MCO 1510.35, June 1981.
- Individual Training Standards (ITS) System; Volume II - Job Performance Measures (JPMs) for the Infantry Occupational Field (Occ Fld 03), MCO 1510.36, July 1981.
- Recruit Outline, Recruit Training Regiment, Parris Island, S.C., August 1979.
- Lesson Plans, Recruit Training Regiment, San Diego, CA, 1981

2.4.1.3 Infantry Training School Curriculum. LAV training consists of a basic course, advanced and officer course.

The basic course will provide recruits with their first exposure to the LAV. Turret operations operator maintenance and basic gunnery skills training will be accomplished in 1-2 weeks out of the total 6 week period. The advanced course, also referred to as the unit leaders course, will provide Marines with training to refine their skills in LAV turret operation, operator maintenance, and acquaint them with some gunnery skills, and in general, provide them with a background which will enable them to serve as LAV trainers in the unit. The officer course will provide those assigned secondary MOS 0303 with a background in operations and maintenance of the LAV. At this time, documentation on the ITS LAV training is being developed by ITS and Marine Corps Headquarters. Preliminary training objectives were determined based on interviews with ITS curriculum developers and LAV training staff. Documentation reviewed is shown in Table 2-8.

TABLE 2-8. ITS TRAINING CURRICULUM DOCUMENTS

- Commanding Officer, ITS, Camp Pendleton, CA, 92055 letter 3/DLB/sjs over 1500 dtd 21 March 1983, to CMC (TDG-32); subject ITS Course Length Extension.
- Individual Training Standards (ITS) System; Volume I - Training Objectives for the Infantry Occupational Field (Occ Fld 03), MCO 1510.35, June 1981.
- Individual Training Standards (ITS) System; Volume II - Job Performance Measures (JPMs) for the Infantry Occupational Field (Occ Fld 03), MCO 1510.36, July 1981.
- Requirements Statement for an Instructional Management System for Marine Corps Formal Schools, NAVTRAEQUIPCEN Report AMD-20, November 1980.

2.4.1.4 Unit Training. The unit program will provide for basic and advanced enlisted and officer training. The essential purpose of unit training is to provide individual skills refresher/refinement training and crew training. In the event that Marines assigned to LAV units through lateral transfer cannot immediately be scheduled for training at the

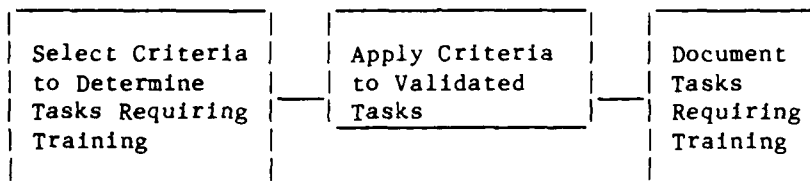
institution, the unit program must also be capable of providing suitable training pending available ITS quotas.

Documentation on unit training activities is currently being developed by Company A, 1st LAV Battalion. Discussions with unit personnel provided a general overview of training objectives with further refinement anticipated in the near future.

#### 2.4.2 Tasks to be Trained

An analysis was performed using the validated tasks listing as the source document that resulted in identification of those tasks requiring formal training. Figure 2-4 illustrates the steps used in this analysis.

Figure 2-4. Analysis of Tasks Requiring Training.



2.4.2.1 Selection of Criteria to Determine Tasks Requiring Training. The initial step in the analysis was to select criteria to determine those tasks in the validated task listing that required formal training. The criteria selected to determine which tasks require training are listed in Table 2-9. The decision to select these criteria was based on guidance from the following sources: (1) Interservice Procedures for Instructional Systems Design (TRADOC PAM 350-30), (2) U.S. Army's Job and Task Analysis Handbook (TRADOC PAM 351-4T) and (3) E-Tech's previous experience in using these criteria for similar task and media analysis efforts.

TABLE 2-9. SELECTION CRITERIA FOR TASKS REQUIRING TRAINING

CRITERIA	DESCRIPTION OF CRITERIA
N: New Step/Activity	Is this step/activity new to the student?
CD: Unusual Condition	Are there restricting conditions under which the step/activity must be performed? For example, restricted visibility, noise, work space restrictions, moving vehicle, etc. Are there delayed tolerances which must be met? For example, are there steps/activities, that if not completed in a specified time period, will result in task failure but not endanger personnel or equipment?
CT: New or Strict Criteria	Are there time and error specifications that cannot be met without training?
NTR: Negative Transfer	If the students perform this step/activity on the LAV system as they have learned to previously on other systems, will they perform the task incorrectly?
TLEQ: Tools and Equipment	Are new tools or equipment used to perform this step/activity?
SFHZ: Safety Hazard	If the student performs this step/activity incorrectly, is there potential for personnel injury or damage to the equipment?

These criteria were used to ensure that a comprehensive data base was obtained from which training requirement determinations could be made. These criteria are concerned with previous training of the task, unusual conditions in which to perform the task, new or strict criteria which must be adhered to, the possibility of negative transfer, the use of new support tools or equipment, and safety issues associated with task performance.

2.4.2.2 Apply Criteria to Validated Task List. Working with Marine Corps SMEs, E-Tech analysts applied the criteria to the validated task listing (working meeting at E-Tech, Orlando, 27 June - 6 July). Each LAV task was analyzed in terms of the training selection criteria listed in Table 2-9.

Since numerous steps/activities comprised any given LAV job task, each step/activity for a particular task was analyzed according to the established criteria. Thus, each specific step/activity within a LAV task was categorized as to requiring training or not. In order to ensure accurate and comprehensive data collection from interviews with the SMEs, E-Tech analysts designed a data collection form (LAV Form 1) incorporating these selection criteria. A sample of LAV Form 1 is provided in Figure 2-5.

2.4.2.3 Document Tasks Requiring Training. Based on the results of the application of the criteria, every task and supporting steps were classified as requiring or not requiring training. The result of this process is discussed in Section 3.4.3 and tasks documented in Appendix E.

2.4.3 Tasks Requiring Hands-On Training (HOT). Once the tasks requiring training were determined, it was necessary to identify which of those tasks required hands-on training. This procedure was similar to the process used to identify tasks requiring training discussed in 2.4.2. Figure 2-6 illustrates the steps used to identify tasks requiring hands-on training.

2.4.3.1 Selection of Criteria for Tasks Requiring Hands-On Training (HOT). Once those tasks determined to require formal training were identified, they were analyzed to determine which tasks could most effectively be trained with hands-on training. The criteria selected to determine which tasks require hands-on training are listed in Table 2-10. The decision to select these criteria was based on the same sources used to select training criteria and also, on ARI Research Product 80-25, How to Determine Training Device Requirements and Characteristics: A Handbook for Training Developers.

Criteria used to determine hands-on training requirements are concerned with the difficulty of the task, unusual conditions for task performance, and strict performance criteria to be adhered to when performing the task. Other issues of concern are with cues and feedback from the hardware, tools or equipment used in task performance, safety issues, and the frequency in which the task is performed.





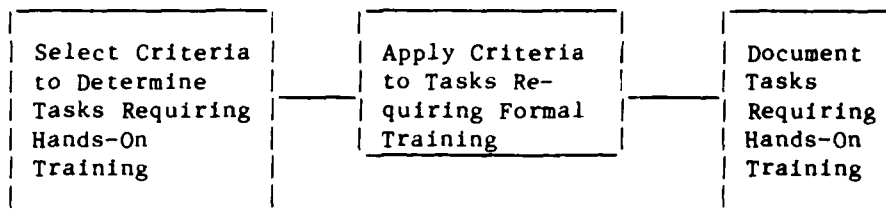


Figure 2-6. Analysis of Tasks Requiring Hands-On Training.

#### 2.4.3.2 Apply Criteria to Task Listing Requiring Formal Training.

Working with the Marine Corps SMEs, E-Tech analysts applied the criteria to each of the tasks which had been identified as requiring training. This process was accomplished during the working meeting at E-Tech, Orlando (27 June - 6 July) and during a site visit to Aberdeen Proving Grounds (2 August - 4 August).

For the identification of HOT tasks, a second data collection form, Figure 2-7, was designed (LAV Form 2). Using Form 2, each step/activity that was determined to require training in LAV Form 1 was analyzed to arrive at the skills/knowledge required to perform the task. Each skill/knowledge was then analyzed to determine if it required training based on selection criteria described in Table 2-9. Based on information obtained from SMEs and criteria described in Table 2-9, E-Tech analysts determined which skill/knowledge requiring training could most effectively be trained with hands-on training.

TABLE 2-10. TASK SELECTION CRITERIA FOR  
HANDS-ON TRAINING REQUIREMENTS

CRITERIA	DESCRIPTION OF CRITERIA
Difficult	Is the skill/knowledge difficult to execute?
Unusual Condition	Is the display of the skill or knowledge required in unusual circumstances such as noisy or limited access environments?
Criteria	Is the timing or the error criteria so strict as to require experience performing that task on equipment?
Hardware Cues	Does the operator receive feedback from the equipment? Skills/knowledge that require, for example, visual, tactual or auditory feedback from the hardware should be practiced on hardware.
Tools/Equipment	Are new/modified support tools or test equipment used to execute the skill/knowledge?
Safety Hazard	Are the consequences of inaccurate performance high in terms of personal injury or equipment damage?
Time/Frequency	What is the frequency of the skill/knowledge performance? If the skill/knowledge is performed very often or very infrequently, practice on hardware may lead to improved efficiency.



2.4.3.3 Documentation of Hands-On Training Requirements. Based on results of the application of the criteria, every task and supporting skills/knowledge for every step were classified as requiring or not requiring hands-on training. The results of this process are discussed in Section 3 and tasks documented in Appendix E.

Skills/knowledges were identified as requiring training device support if one or more of the following situations existed:

- The skill or knowledge is difficult to execute.
- Unusual conditions exist which are associated with task performance.
- Timing or error criteria is so strict as to require experience performing the task on equipment.
- The student receives feedback from the hardware such as visual, auditory, or tactual.
- New/modified tools on test equipment are used to execute the skill/knowledge.
- Improved performance of the skill/knowledge could result in personal injury or damage to the equipment.
- Frequency of the task is such that additional practice on hardware will lead to improved efficiency.

## 2.5 Training Media Alternatives

Most instructional and training experts agree that at least two factors determine the success of a training device: functional fidelity and physical fidelity. This is especially true of tasks requiring hands-on-training (HOT). Unless the required degrees of functional and physical fidelity are present in the learning environment, learning may be incomplete and lengthy, and transfer of training is likely to be less than it might otherwise be.

Physical fidelity means that the training program must capture the essential operational and physical conditions present in the real life situation for which the student is being trained. Functional fidelity refers to the ability of the training device hardware and software to provide stimulus and/or equipment feedback appropriate for the tasks to be learned by the trainees.

In moving from a listing of HOT tasks to describing the nature of the training devices required to teach these skills, appropriate media must be described and evaluated against the physical and functional fidelity requirements associated with the tasks to be trained. Based on this analysis, media alternatives that will support the training of all or the majority of the tasks requiring training will be identified. Later, existing or planned training devices and/or equipment that would meet the requirements of the media alternatives will be identified and evaluated. Finally, a tradeoff analysis will lead to a recommended training system.

Media alternatives were derived for HOT tasks using a three step process. First, hardware fidelity requirements were described for each HOT task. Next, these requirements were examined with respect to the stimulus presentation, response, and feedback capabilities required to support learning and practice. During this step, HOT tasks were grouped into related learning categories. This made it possible to identify composite media attributes for each group, thus potentially minimizing the absolute numbers and variety of media required to support training. Finally, the media attributes derived for each group of HOT tasks were evaluated with respect to state-of-the-art, generic training devices/equipment to identify candidate media alternatives for the LAV program. In the remainder of this section of the report, this process is described in detail. In Section 3.5, the results of applying this process will be described.

2.5.1 Determination of Hardware Fidelity Requirements. As the first step in deriving appropriate media for LAV-25 HOT tasks, physical and functional fidelity requirements for these tasks were described. This was done in two phases. First, LAV SMEs (Captain T.M. Lytle, USMC; Captain D.L. Beeman, USMC; and Gy Sgt. N.W. Smithee, USMC), working with E-Tech analysts at

the Orlando, Florida, E-Tech facility, reviewed each step and activity associated with each HOT task identified earlier in the project and identified the following physical and functional fidelity information:

- Specific component(s) involved in performing the step/activity.
- Stimulus or cue initiating the step/activity.
- Response expected of the student.
- Feedback provided to the student as a consequence of performing the step/activity to include feedback provided when performance was correct or when performance was incorrect.

This information was recorded on a Fidelity/Media Summary Form along with other identifying data such as a task and step/activity identifying number, the task and step/activity title, the date on which the data were collected, and the SME source of information. An example of a Fidelity/Media Summary Form is presented in Figure 2-8. Data reflecting the physical and functional fidelity requirements of an example task step (Charge, clear, and safe gun) is depicted in this figure.

Following examination of all HOT tasks, the data were reviewed for completeness. In some cases, it was discovered that the fidelity data required clarification. This was especially true for LAV-25 tasks that were infrequently performed or for which complete documentation was lacking or unavailable. To obtain the required clarification, E-Tech analysts traveled to the Aberdeen Proving Grounds, Aberdeen, Maryland, where a LAV prototype was available to support clarification of LAV HOT task fidelity requirements. Again working with LAV SMEs (1st Lt D. Barnes, USMC; Gy Sgt W.W. Smithee, USMC; and Sgt R.G. Hunnicutt, USMC), the LAV HOT tasks were further reviewed in conjunction with a hands-on examination of the LAV to verify stimulus, response, and feedback fidelity requirements that required clarification. The product of this activity was a complete description on a task by task basis of the physical and functional fidelity requirements for each step/activity comprising the LAV HOT.

11. TASK/SUBTASK NO.	2. TASK/SUBTASK TITLE	3. INITIALS	4. DATE	5. PAGE OF	6. SOURCE
10	REMOVE AND INSTALL	RZ	8-2-83	1	SME - SGT HUNNICUT USMC
7. SKILLS AND KNOWLEDGE	8. 15 SE TO	9. COMPONENT	10. STUDENT STIMULUS/QUE	11. STUDENT RESPONSE	12. FEEDBACK
10.3.2 COAX DISASSEMBLY	10.3.2.1 CHARGE, CLEAR AND SAFE GUN	<ul style="list-style-type: none"> <li>● CHARGING HANDLE</li> <li>● FEED COVER</li> <li>● FEED TRAY</li> <li>● SAFETY</li> </ul>	<ul style="list-style-type: none"> <li>● CHECK LIST</li> <li>● "</li> <li>● "</li> <li>● "</li> </ul>	<ul style="list-style-type: none"> <li>● PULL TO REAR</li> <li>● RAISE</li> <li>● RAISE AND HOLD</li> <li>● PUSH LEFT TO RIGHT</li> </ul>	<ul style="list-style-type: none"> <li>● BOLT LOCK IN PLACE</li> <li>● STAYS UP</li> <li>● HOLD AND VISUALLY INSPECT CHAMBER</li> <li>● CLICKS INTO PLACE</li> </ul>

Figure 2-8 Example of a Completed Fidelity/Media Summary Form.

2.5.2 Determination of Media Attributes. Media attributes must be capable of providing the critical characteristics of the actual equipment which cue student performance of HOT tasks. These can be categorized as:

- Stimulus Presentation, i.e., the manner in which task requirements, cues and/or information is presented to the student.
- Response Acceptance, i.e., the mechanism by which the student responds to stimulus presentations.
- Feedback, i.e., the manner in which the system responds to student inputs including both correct and incorrect inputs or the failure to make an input.

The functions associated with these components may be performed by a single piece of equipment, a single individual, or a combination of both. For example, stimulus information may be presented via a slide projector under instructor control; student response may be a control input to a mechanical replica of the system for which training is being conducted; and the system response may be made by a computer system which has been programmed to sense, select and provide physical analog of the appropriate feedback. Alternatively, the entire instructional sequence may occur entirely between the student and an electro-mechanical or computer-controlled training system comprising stimulus presentation, response acceptance, and feedback mechanisms.

In paragraph 2.5.2 the stimulus presentation, response acceptance, and feedback requirements for all LAV HOT task steps/activities were collected. This data was examined by E-Tech analysts to determine the specific media attributes required for stimulus, response and feedback information flows during HOT task training. This was completed as a two step process.

First, HOT tasks were organized into related learning categories according to the following rules:

- Tasks were grouped together because common equipment items were used in their performance.



- Tasks were grouped together because they were typically learned or performed together as part of a timed sequence such that performance of the next task in the sequence was cued by performance of the immediately proceeding task.
- Tasks were grouped together because their learning was based on a "common core" of related skills and knowledge.

The objective of the grouping was to partition the overall set of HOT tasks into a number of individual sets of tasks that could easily be treated as a unified whole. In this way, when media attributes were derived, they would organize themselves to point to a relatively small sample of candidate training media for each related learning category. This would in turn narrow to a manageable level the number of different types of state-of-the-art, generic training devices/equipment to be considered in developing recommendations for appropriate LAV training media.

Next, for each group of related HOT tasks, media attributes were derived by E-Tech analysts. This was done using the guidelines presented in Tables 2-11, 2-12, and 2-13, which were extracted from Jorgensen and Hoffer (55). In deriving attributes, the E-Tech analysts reviewed each physical and functional fidelity requirement associated with each HOT task. The nature of the requirement was determined (either stimulus presentation, response acceptance, or feedback); the appropriate set of guidelines was reviewed (either Table 2-11, 2-12, or 2-13) and applied to the requirements; and a description of the required media characteristics was prepared. An example of this process is shown schematically in Figure 2-9. Finally, after all tasks within a group had been analyzed in this manner, the resulting media attributes were categorized and summarized to reflect the overall requirements for each category of related HOT tasks.

2.5.3 Determination of Media Alternatives. In this final step of the media analysis process, the media attributes identified for each category of related HOT tasks were compared to state-of-the-art, generic training devices/equipment to identify candidate media alternatives for the LAV program. In making these comparisons, five types of state-of-the-art devices/equipment were considered:

TABLE. 2-11

## GUIDELINES FOR DESCRIBING STIMULUS PRESENTATION ATTRIBUTES

STIMULUS PRESENTATION FACTORS	STIMULUS ATTRIBUTES	STIMULUS PRESENTATION FACTORS	STIMULUS ATTRIBUTES
<u>Medium of Stimulus Presentation</u>	<ol style="list-style-type: none"> <li><u>Visual Cues</u> - Signals received through the sense of sight.</li> <li><u>Audio Cues</u> - Signals received through the sense of hearing.</li> <li><u>Tactile Cues</u> - Signals received through the sense of touch, including sensations related to texture, size, shape, or vibration of the skin.</li> <li><u>External Stimulus Motion Cues</u> - The sensations felt by a person when he is moved by some outside force in such a way that his body experiences roll, pitch, yaw, heave, sway and/or surge.</li> <li><u>Internal Stimulus Motion Cues</u> - The sensations felt by a person when he moves his arm, leg, fingers, etc.</li> <li><u>Olfactory Cues</u> - Signals received through the sense of smell.</li> <li><u>Gustatory Cues</u> - Signals received through the sense of taste.</li> </ol>	<u>Visual Scale</u>	<ol style="list-style-type: none"> <li><u>Exact Scale</u> - Actual visual field or a one-to-one replication of field as with a full-sized mock-up, simulator, or operational system.</li> <li><u>Proportional Scale</u> - A representation of reality in other than full scale, such as a scaled model map or photograph.</li> </ol>
<u>Visual Form</u>	<ol style="list-style-type: none"> <li><u>Visual Alphabetic</u> - Words and/or numbers presented visually.</li> <li><u>Visual Symbolic</u> - Symbols presented graphically.</li> <li><u>Visual Graphic</u> - Two-dimensional figures, such as maps, graphs, mathematical curves, etc., presented visually.</li> <li><u>Visual Pictorial</u> - Two-dimensional images, such as photographs, drawings, etc., presented visually.</li> <li><u>Visual Solid Object</u> - A three-dimensional image or reality that is viewed from exterior perspectives.</li> <li><u>Visual Environment</u> - A three-dimensional image or reality that is viewed from inside.</li> <li><u>Visual Still</u> - A static visual field, as with a still photograph, drawing or printed page.</li> <li><u>Visual Limited Movement</u> - A basically static visual field with elements that can be made to move, as with an animated transparency or slide panel with switches that move.</li> </ol>	<u>Audio Sources</u>	<ol style="list-style-type: none"> <li><u>Tonal Sound</u> - A very limited source of sound or noise which is used, rather than speech, for signaling or warning, e.g., horns, whistles, sirens, bells, buzzers, etc.</li> <li><u>Voice Sound</u> - A limited source of sound which enables spoken words to be used as the medium of communications, but not suited to more demanding tasks, such as music or sound recognition exercises.</li> <li><u>Full Sound</u> - A source of sound that contains all the significant elements of the sound and is suited to the demanding task of sound recognition exercises.</li> <li><u>Ambient Sound</u> - A complex sound environment with sounds emanating from various sources and from various directions, including background noise and task significant sounds.</li> </ol>
<u>Visual Movement</u>	<ol style="list-style-type: none"> <li><u>Visual Full Movement</u> - A visual field in which all elements can move, as with a motion picture, flight simulator, or operational aircraft.</li> <li><u>Visual Cyclic Movement</u> - A visual field which moves through a fixed sequence and then repeats the sequence in a repetitive manner, as with a film loop.</li> </ol>	<u>Stimulus Presentation Rate</u>	<ol style="list-style-type: none"> <li><u>Slow Rate</u> - A slow rate or speed of presentation of stimuli to the trainee, allowing the trainee a long or maximum stimulus analysis time.</li> <li><u>Fast Rate</u> - A fast rate or speed of presentation of stimuli to the trainee, allowing the trainee a short or minimum stimulus analysis time.</li> </ol>
<u>Visual Spectrum</u>	<ol style="list-style-type: none"> <li><u>Black and White</u> - A visual field composed of either black or white elements, as with the printed page or line drawings.</li> <li><u>Gray Scale</u> - A visual field composed of black, white and continuous gradations of gray, as with a black and white photograph or television picture.</li> <li><u>Color</u> - A visual field composed of various segments of the visual spectrum, as with color television or motion pictures.</li> </ol>	<u>Number of Channels or Sources</u>	<ol style="list-style-type: none"> <li><u>Limited</u> - A small number of sources, channels, or instruments through which stimuli are presented to the trainee.</li> <li><u>Unlimited</u> - A multiple number of sources, channels, or instruments through which stimuli are presented to the trainee.</li> <li><u>Individual</u> - All information is presented directly to one individual trainee.</li> </ol>
		<u>Stimulus Distribution</u>	<ol style="list-style-type: none"> <li><u>Group</u> - Information is presented to a group of trainees, allowing only indirect access to the information for an individual.</li> </ol>

TABLE 2-12  
GUIDELINES FOR DESCRIBING RESPONSE ACCEPTANCE ATTRIBUTES

RESPONSE ACCEPTANCE FACTORS

RESPONSE ATTRIBUTES

Response Mode of Implementation

1. Overt Response - Verbal - A response which the trainee expresses in an audible (verbal) manner, such as a verbal short answer response to a question having a limited set of correct answers, a conversational response, or a verbal decision response.
2. Overt Response - Written - A response which the trainee expresses in an observable (written) manner, such as a free style written response, a written multiple choice response, or a written fill-in-the blank response.
3. Overt Response - Manipulative Acts - A response which the trainee expresses in an observable (manipulative) manner, such as the small movements of dials, switches, keys, or small adjustments to instruments or the large movements of levers, wheels or use of hand held tools.
4. Overt Response - Tracking - A response which the trainee expresses in an observable (tracking) manner, such as continuously controlling a constantly changing system, e.g., steering an automobile.
5. Overt Response - Procedural Performance - A response which the trainee expresses in an observable (procedural performance) manner, such as performing a sequence of steps in a procedure, e.g., carrying out the items on the checklist for preflighting an aircraft or turning on a radar system.

Intensity of Response

6. Weak - Responses made by the trainee with weak intensity.
7. Strong - Responses made by the trainee with strong intensity.

Response Implementation

8. Static - A unitary response situation, i.e., responses are made by the trainee "all at once".
9. Dynamic-Ordered - A sequential response situation, i.e., responses are made by the trainee sequentially or in an ordered manner over time.
10. Dynamic-Random - A non-sequential response situation, i.e., responses are made by the trainee randomly over time.

Required Response Rate

11. Slow Rate - A slow rate or speed of trainee response, i.e., a rate which allows the trainee a long or maximum response time.
12. Fast Rate - A fast rate or speed of trainee response, i.e., a rate which allows the trainee a short or minimum response time.

Number of Response Channels

13. Limited - A limited number of sources, channels, or instruments through which required responses are made by the trainee.
14. Unlimited - An unlimited number of sources, channels, or instruments through which responses are made by the trainee.

Response Distribution

15. Individual - One individual trainee makes the required response.
16. Group - A group of trainees make the required response.

TABLE 2-13

GUIDELINES FOR DESCRIBING FEEDBACK ATTRIBUTES

FEEDBACK EVALUATION FACTORS	FEEDBACK ATTRIBUTES
<u>Medium of Feedback Presentation</u>	<ol style="list-style-type: none"> <li>1. <u>Visual</u> - Feedback presented visually by means of a display, it may be coded and transmitted visually to the trainee.</li> <li>2. <u>Aural</u> - Feedback presented aurally by means of a display to the trainee.</li> <li>3. <u>Written Form</u> - Feedback presented to the trainee in written form.</li> <li>4. <u>Face-to-Face Communication</u> - Feedback presented by direct verbal means to the trainee.</li> <li>5. <u>Indirect Communication</u> - Feedback presented by indirect verbal means, such as by intercom, telephone, or radio link.</li> <li>6. <u>Tactile</u> - Feedback presented to the trainee through the sense of touch, including sensations related to texture, shape, size, or vibration of the skin.</li> <li>7. <u>Kinesthetic</u> - Feedback presented to the trainee by either internal or external bodily movement, such as reaching, grasping, tilting, etc.</li> <li>8. <u>Olfactile</u> - Feedback presented to the trainee through the sense of smell.</li> <li>9. <u>Gustatile</u> - Feedback presented to the trainee through the sense of taste.</li> </ol>
<u>Source of Feedback</u>	<ol style="list-style-type: none"> <li>10. <u>Intrinsic F</u> - Information or cues built into the system from which the trainee interprets feedback information.</li> <li>11. <u>Extrinsic F</u> - Information or cues not inherent in the trainee action or system operations but is supplied by an external source.</li> </ol>
<u>Type of Feedback</u>	<ol style="list-style-type: none"> <li>12. <u>Research Correctness (Rcr)</u> - Information about the correctness or incorrectness of trainee's response, when several response alternatives are possible and the correct choice is not known to the trainee in advance. (Also known as augmented feedback.)</li> <li>13. <u>Response Correctness (Rcf)</u> - Information provided to the trainee (or others who need to know about his performance) that he has in fact performed an operation, but does not say anything about the longer range consequences of the action taken.</li> <li>14. <u>Response Consequences (Rcn)</u> - Information about the consequences of the action taken. It confirms the response made by the trainee, and the correctness of a response can be inferred only from its consequences. May also serve to cue the trainee to perform the next response in sequence.</li> <li>15. <u>System Status (Rss)</u> - Information about the condition of one's own or another system or the external environment, on the basis of which a trainee or team must act. Information is not necessarily (or even frequently) the immediate consequence of or follow-on to a specific trainee/team action; it may reflect system events that have been put in motion by much earlier trainee actions. Provides information that regulates trainee and system actions in the sense that when a particular status condition occurs, the trainee must often take action to maintain the integrity of his system.</li> </ol>
<u>Feedback Distribution</u>	<ol style="list-style-type: none"> <li>16. <u>Individual</u> - Feedback is presented to one individual trainee.</li> <li>17. <u>Group</u> - Feedback is presented to a group of trainees, allowing only indirect access for an individual.</li> </ol>

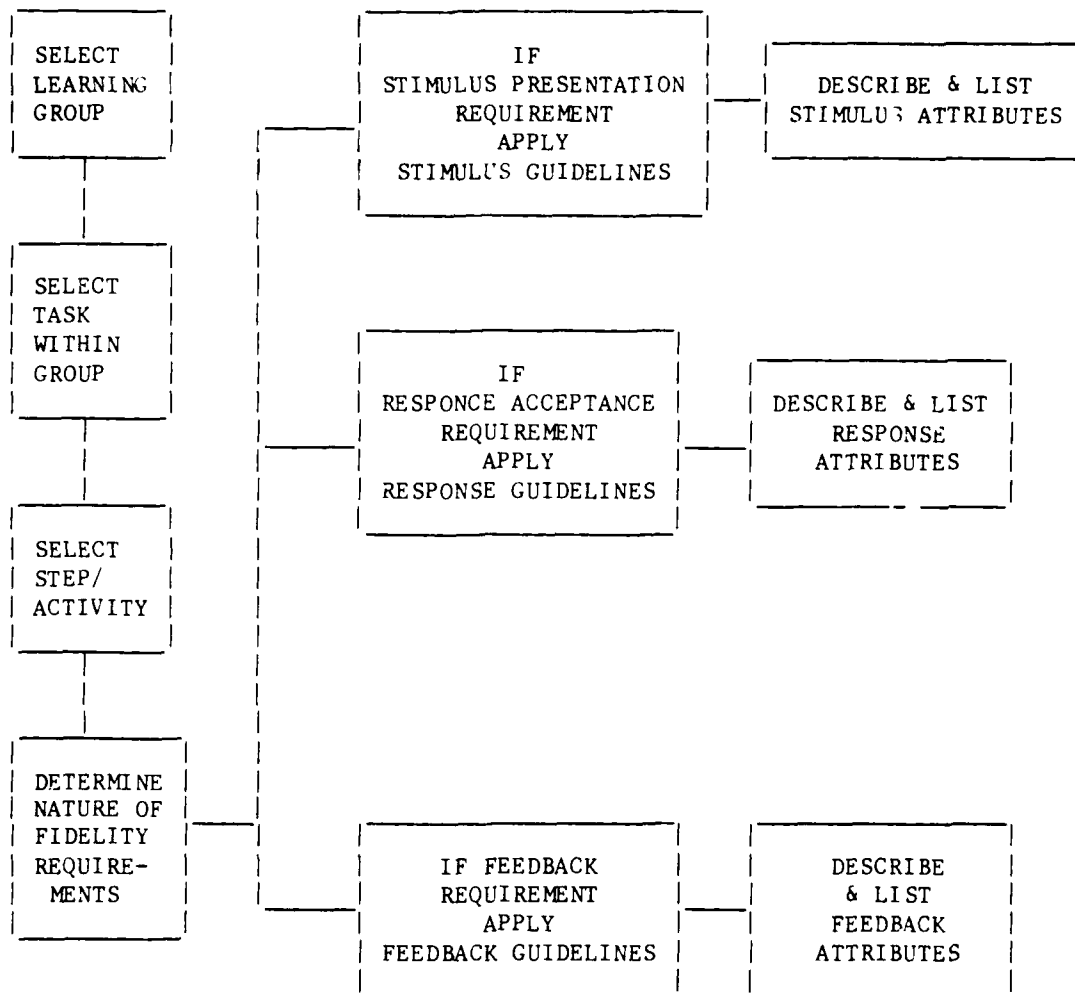


Figure 2-9. Schematic of Process Used to Derive Media Attributes.

- Actual Equipment with Substitution Firing Device
- Dynamic Models
- 2D/3D Panel Trainers
- Procedures Trainers
- 3D Mock Ups

The characteristics of these devices/equipment are summarized in Table 2-14. These devices effectively represent a continuum of physical and functional fidelity such that as one moves along this continuum from low to high physical and functional fidelity, the nature of the associated training device changes from the mock-up at the low end of the scale to actual equipment with substitution device at the top of the scale. Typically, but not always, as fidelity requirements increase, so does the cost of the media required to meet these requirements. Thus, in choosing media to adequately support training, a major objective is to identify those media which have only the fidelity required for learning to occur. In this way, costs are kept to a minimum, and the amount of "bang" for the buck is maximized.

Thus, in determining appropriate media to support LAV HOT training tasks, the media attributes for each group of related HOT tasks were compared to the stimulus, response acceptance, and feedback capabilities of the five types of devices/equipment described in Table 2-14. This was done taking into consideration USMC training requirements for Basic, Advanced, Officer, and Unit training for the LAV. The result of these comparisons is presented in Section 3.5 identifying the media alternatives providing the minimum required degree of functional and physical fidelity.

TABLE 2-14. SUMMARY OF TRAINING DEVICE/EQUIPMENT CHARACTERISTICS

CHARACTERISTIC	ACTUAL EQUIPMENT (AE) WITH SUBSTITUTION DEVICE	DYNAMIC MODELS	TRAINING DEVICE/EQUIPMENT 2D/3D PANEL TRAINERS	PROCEDURES TRAINERS	3D MOCK-UP
External Configuration	AE	Similar to AE	Flat Panels	Replicates AE as required	Similar to AE
Components	AE except for substitution device	AE or high fidelity simulation	2D/3D mix (3D components with diagrams or pictorial representations of non-operational components)	Limited number of components; high physical fidelity; mechanical moving parts replicated	High physical fidelity; mechanical moving parts replicated
Feedback	Dynamic feedback provided by the substitution device which is similar to feedback of AE	Visual and audio feedback	Text messages, slides, video disk or other audiovisual medium provides feedback	Dynamic feedback for components	No dynamic feedback except from simple, discrete on/off lights or audio generators
Use of Software	May be required	Software models of system functioning drive the presentation of visual and audio feedback	Software models of system functioning drive the presentation of all planned feedback	As required to provide components dynamic operations	None required

## SECTION 3

### RESULTS

#### 3.1 Introduction

Section III provides documentation and results of those steps discussed in Section II. A description of findings is provided for:

- Literature Search
- Task List
- Tasks Requiring Hands-On Training
- Training Media Alternatives

The results of each of the above steps are described in the following paragraphs.

#### 3.2 Literature Search

The results of the literature survey fall into four basic categories as follows:

- Identification of other LAV-25 and LAV-similar studies
- Identification of current and previous studies relating to Gunnery Skills and Armored Vehicle Training
- Identification of lessons learned for particular analysis methodologies
- Contribution to development of LAV task listings

With respect to the first category, the literature search did not lead to the identification of any on-going or past studies specifically concerned with LAV-25 training. This is not surprising since the LAV-25 program is relatively new. Too little time has elapsed since the program was started for many studies to have been completed and reported in the literature. However, as mentioned in the discussion of personal contacts as a literature source, the Army's LAV task list was determined to exist and was obtained from the United States Army Infantry School via their Directorate of Training



Developments. One other highly relevant study obtained in this manner was the Lenzycki, Eckenrode, and Hamilton study (63) for the MICV/TBAT II Infantry Fighting Vehicle (IFV). This study yielded descriptions of tasks performed by IFV crew members for mounted operations in a squad vehicle and when operating in support of a dismounted squad. Tasks were described to the element level, and the squad members allocated to perform each task were identified. This study was quite helpful during the task list development process in that it provided somewhat of an independent check of the adequacy and coverage of fighting vehicle tasks performed by the LAV-25 vehicle commander and gunner for IFV and LAV common/similar weapon systems.

A number of previous studies were located relating to Gunnery Skills and Armored Vehicle Training. Examples of these are Kraemer and Boldovici (59), Hughes (53), Harris, et. al. (44), O'Brien, et. al. (75), Boldovici (5), and Black and Kraemer (4). While these studies generally addressed the problem of individual and crew armor skills, they involved large caliber main gun systems (e.g., 90mm or 105mm). However, for weapons common to these systems and the LAV-25 (e.g., 7.62mm coaxial machine gun and grenade launchers), information contained in these studies was helpful in verifying system operation and target engagement skills. Finally, more generally related to the topic of Armor training and gunnery were several very helpful field manuals obtained from LAV staff members' personal report collections or through the U.S. Marine Corps and/or the U.S. Army:

- U.S. Army. Tank Gunnery. FM-17-12. Washington, D.C.: HQ Department of the Army, March 1977.
- U.S. Army. Tank Gunnery Training. TC 17-12-5. Fort Knox, KY: U.S. Army Armor School, 1975.
- U.S. Army. Training Tank and Sheridan Crews to Shoot. TC 17-12-2. Fort Knox, KY: U.S. Armor School, (undated).
- U.S. Army. Tank Gunnery for XM1 Main Battle Tank. FM 17-12-1 (Draft). Washington, D.C.: HQ Department of the Army, May 1978.

- U.S. Marine Corps, Light Armored Vehicle (LAV) Manpower, Personnel, and Training Assessment. Warren, MI: Integrated Logistic Support Office, U.S. Army Tank-Automotive Command, May 1982.
- U.S. Army, Light Armored Vehicle (LAV-25) Gunnery Program. Briefing Materials. Fort Benning, GA: U.S. Army Infantry School, 30 June 1983.

In reviewing the literature initially brought together for the project, a major objective was to verify that the methodology proposed for the LAV-25 study was not only workable but efficient and reflective of past lessons learned. Several reports were surveyed with respect to analysis methodology, e.g., Lenzycki and Finley (64), Kraemer, Boldovici, and Boycan (59) and Jorgensen and Hoffer (55). These documents were supportive of the LAV-25 project methodology in that they suggested or employed similar procedures for developing tasks lists and defining training requirements, especially in the area of Army gunnery training.

Also, the Lenzycki and Finley (64) report was very helpful in its discussion of mission-oriented function/task block diagrams to systematically describe and display the functions a system must accomplish during each phase of a mission and the tasks that are performed to accomplish the function. A significant contribution to the analysis effort was also made by the Kraemer, Boldovici, and Boycan study (59) in that it provided explicit rationales for selecting and describing the conditions or variables that can affect a vehicle crew's ability to neutralize targets on the battlefield. Additionally, for the Jorgensen and Hoffer report (55), the list of media attributes recommended for use in the media analysis and selection process was extracted and adopted to the specific research needs of the LAV-25 media analysis process.

Finally, there were a number of very useful documents that served as the basis for developing the preliminary LAV-25 task listings. These are summarized in Table 3-1. In general, these materials reflect technical documentation provided by the LAV-25 contractor (General Motors of Canada), the U.S. Army and the U.S. Marine Corps. The major difficulty in using this material was its sheer volume. Extraction, evaluation of relevancy, and

TABLE 3-1. SUMMARY OF DOCUMENTS SUPPORTING DEVELOPMENT OF LAV TASK LIST

DOCUMENT TITLE	SOURCE OF DOCUMENT	DATE
PIRANHA: LAV-25 (MC) Turret Operator's Handbook	Canadian Commercial Corporation - GM Corp.	3 June 1983
Operator's Manual LAV-25 (MC) Turret: Commercial Manual Initial Issue	Canadian Commercial Corporation - GM Corp.	15 April 1983
Turret and Weapon Station Task List	Lt Col. A. Powell, HQ U.S. Marine Corps	27 April 1983
Light Armored Vehicle Turret Operator's/ Maintenance Manual LAV-25 AG 90mm	General Motors of Canada Limited	1 November 1981
Point Paper: Evaluation of Crew Gunnery Proficiency on LAV Weapon Systems	Light Armored Vehicles, Test and Evaluation Branch, Marine Corps Air Ground Combat Center, Twentynine Palms, CA	16 February 1982
Bradley Fighting Vehicle Gunnery FM 23-1 (Working Draft)	U.S. Army Infantry School, Ft. Benning, GA	December 1982
Trainer's Guide: Fighting Vehicle Infantryman MOS 11M FM 7-11M/TG	HQ, Department of the Army, Washington, D.C.	1982
Soldier's Manual: 11M10/20/30/40 Fighting Vehicle Infantryman (Skill Levels 1,2,3,4)	HQ, Department of the Army, Washington, D.C.	1982
Infantry and Calvary Fighting Vehicle Gunnery FM 71-999 A (Draft)	U.S. Army Infantry and Armor Centers	May 1981
Infantry and Calvary Fighting Vehicle Gunnery FM 71-XM 2/3 (Draft)	U.S. Army Infantry and Armor Centers	March 1980

consolidation of all turret related tasks was time consuming and tedious because of this volume. Additionally, because the materials were prepared by a variety of different groups, it was necessary to ensure that there was consistency in nomenclature and the manner in which functions, tasks, sub-tasks, job elements and skills were differentiated.

### 3.3 Task List

The complete task list development and validation process requisite to the Task and Media Analysis is described in Section 2.3 of this report. The overall organization of the task list can be seen in Figures 3-1 and 3-2. The detailed results of this process are presented in Appendix C in the form of a final validated task list for LAV-25 turret, armament and operator maintenance tasks. The task list is divided into eleven numbered mission-oriented task groupings. Each grouping may be further divided, hierarchically, into sequential tasks (one decimal), sub-tasks (two decimals), steps (three decimals) and, in one instance, sub-steps (four decimals). Table 3-2, extracted from the task list, illustrates this hierarchical relationship within task group number 10, concerning performance of removal and installation procedures of the turret armament systems.

The quantification and summing of the tasks, sub-tasks, steps and sub-steps developed within the task list are presented in Table 3-3 by mission-oriented task groups.

The task list presented in Appendix C is final and validated up to the publication date of this report. However, a design freeze date has not been established for the LAV hardware. Accordingly, any future hardware changes occurring up to a designated design freeze will likely require an updating and validating effort for the affected task list areas.

### 3.4 Tasks Requiring Hands-On Training

Determination of tasks requiring hands-on training was accomplished in three steps: Analysis of Entry Level Skills, Determination of Tasks to be Trained and Determination of Tasks Requiring Hands-On Training. This section presents the results of each of these steps.

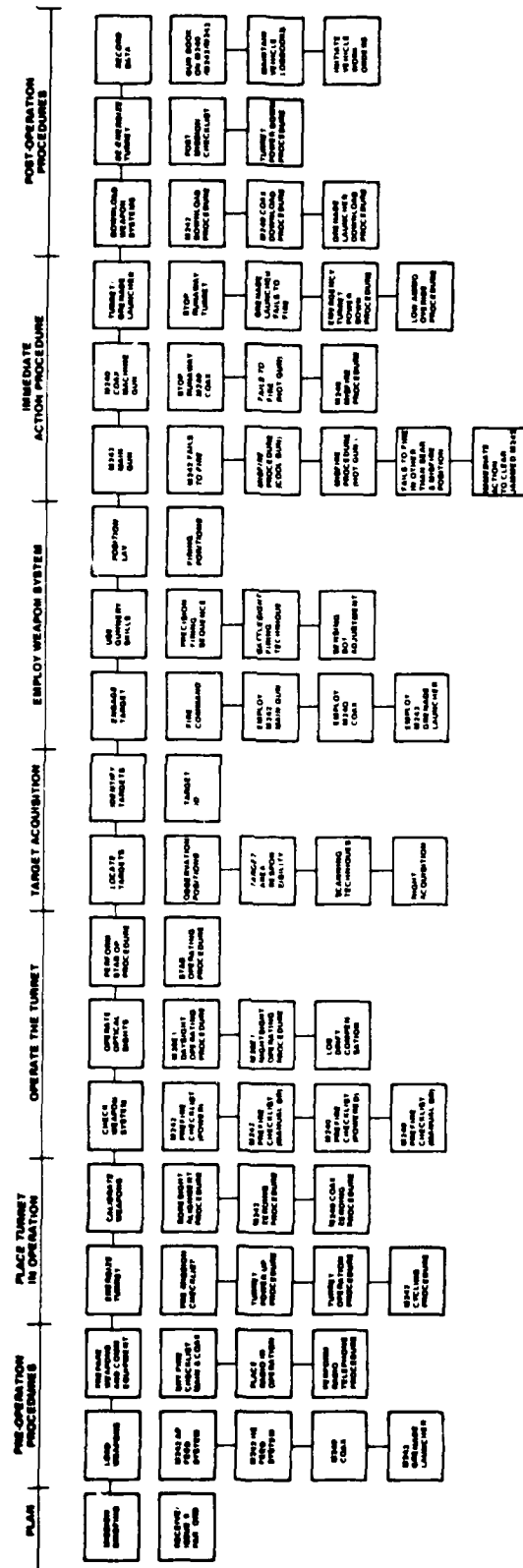


Figure 3-1. LAV-25 Operator Tasks.

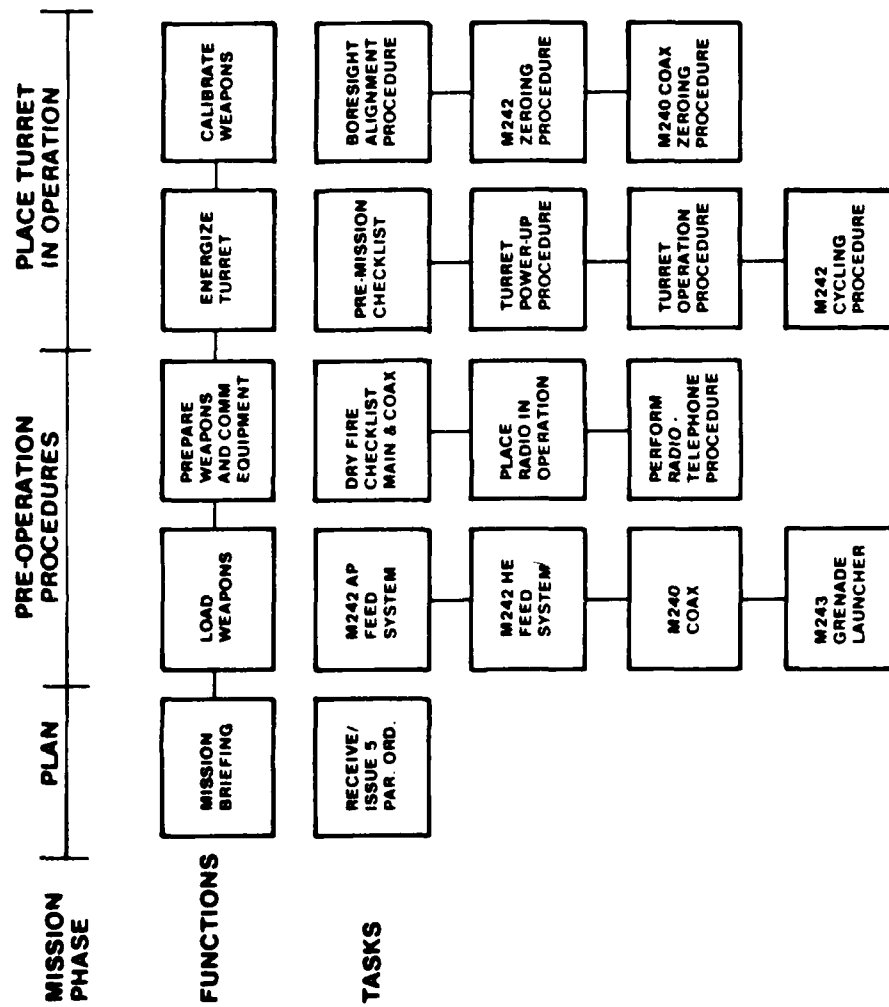


Figure 3-2. LAV-25 Operator Maintenance Tasks.

TABLE 3-2. SAMPLE TASK, SUB-TASK, STEP AND SUB-STEP HIERARCHY

(TASK)	10.3	PERFORM M240 COAX REMOVAL, DISASSEMBLY, ASSEMBLY AND INSTALLATION PROCEDURES.
(SUB-TASK)	10.3.1	Removal.
(STEP)	10.3.1.1	Turn TURRET POWER circuit breaker OFF.
	10.3.1.2	Turn WEAPON POWER circuit breaker OFF.
	10.3.1.3	Position TURRET DRIVE LOCK to LOCK.
	10.3.1.4	Unzip the weapons enclosure bag.
	10.3.1.5	Disconnect electrical connection from solenoid
	10.3.1.6	Pull charging handle to the rear.
	10.3.1.7	Position manual safety to S (safe).
	10.3.1.8	Raise cover assembly.
	10.3.1.9	Remove ammo belt.
	10.3.1.10	Raise feed tray.
	10.3.1.11	Visually and physically verify that chamber is empty.
	10.3.1.12	Remove feed chute.
	10.3.1.13	Remove link chute.
	10.3.1.14	Remove gun-cradle securing pin from rear of COAX.
	10.3.1.15	Pull and hold cradle release lever.
	10.3.1.16	Lift rear of COAX and pull away from gun mount
	10.3.1.17	Release cradle release lever.
	10.3.1.18	Remove COAX from cradle.
	10.3.2	COAX disassembly procedure.
	10.3.2.1	Charge, clear (visually inspect chamber), and safe gun.
	10.3.2.2	Remove barrel.
	10.3.2.2.1	Position safety to S (safe).
(Sub-Step)	10.3.2.2.2	Depress barrel locking latch and hold.

TABLE 3-3. TASK, SUB-TASK, STEP AND SUB-STEP QUANTIFICATION

TASK GROUP	TASKS	SUB-TASKS	STEPS	SUB-STEPS
1. CONDUCT PLANNING	1	-	-	
2. PERFORM PRE-OPERATION PROCEDURES	7	150	-	
3. PLACE TURRET IN OPERATION	7	107	7	
4. OPERATE THE TURRET	8	98	-	
5. PERFORM TARGET ACQUISITION	5	14	19	
6. EMPLOY WEAPON SYSTEM	8	54	36	
7. PERFORM IMMEDIATE ACTION PROCEDURES	12	115	38	
8. PERFORM POST-OPERATING PROCEDURES	8	77	11	
9. PERFORM PREVENTIVE MAINTENANCE (PM)	15	95	43	
10. PERFORM REMOVAL AND INSTALLATION PROCEDURES	4	17	201	4
11. PERFORM OPERATOR TROUBLESHOOTING PROCEDURES	6	37	9	
SUB TOTALS	81	764	364	4
GRAND TOTAL		1213		



3.4.1 Identification of Entry Level Skills. The results of the Entry Level Skills Analysis can only be described as preliminary at this time. Plans for LAV training are being developed and refined by the Marine Corps, and this refinement should and will continue for some time. However, while documented objectives and performance requirements do not exist, the overview of the projected training pipeline, as discussed in Section 2.4.1 does provide some guidance as to the entry level skills which can be assumed for each target population of prospective training device users. Tables 3-4 and 3-5 summarize the essential training elements and prerequisites for both the institutional and unit training environments.

TABLE 3-4. INSTITUTIONAL LAV-25 TRAINING PROGRAM ELEMENTS

	TRAINEES	PREREQUISITE	LENGTH	TYPE TRAINING
BASIC	Assault Team (0312)	Recruit Training	ITS Curriculum	Infantry Skills
	Vehicle Crew (0313)	Recruit Training	Basic ITS + 6 weeks	<ul style="list-style-type: none"> <li>● Driving</li> <li>● Basic <ul style="list-style-type: none"> <li>- Gunnery</li> <li>- Turret Operations</li> <li>- Maintenance</li> </ul> </li> </ul>
ADVANCED	Unit Leaders (0312/0313)	1-2 Years in Unit and/or CPL/SGT	3-5 weeks	<ul style="list-style-type: none"> <li>● Maintenance</li> <li>● Immediate Action</li> <li>● Ammo Handling</li> <li>● Turret Ops</li> <li>● Gunnery</li> <li>● Bore Sighting</li> <li>● Tactics</li> </ul>
	TRAINEES	PREREQUISITE	LENGTH	TYPE TRAINING
OFFICER*	Infantry-0302 Armor-1802 Amphib-1803	2 LT - MAJ	4-6 weeks	Same as Advanced

\* Officers will be assigned secondary MOS 0303. This will not be a primary MOS field for officers.

TABLE 3-5. UNIT LAV-25 TRAINING PROGRAM ELEMENTS

	TRAINEES	PREREQUISITE	DURATION	TYPE TRAINING
BASIC & ADVANCED	0312	Basic ITS and ITS LAV course	TBD by Unit Training Program & Schedule	Refresher and Refinement of Individual and Crew Training.
				<ul style="list-style-type: none"> <li>● Maintenance</li> <li>● Immediate Action</li> <li>● Ammo Handling</li> <li>● Turret Ops</li> <li>● Gunnery</li> <li>● Bore Sighting</li> <li>● Tactics</li> </ul>

3.4.1.1 ITS Basic LAV Training. The basic LAV course is the best defined at this time, both because the recruit training is well defined and because the ITS staff is further along in the planning of this course. It was determined that the recruit entering the basic LAV course has had very little training with direct applicability to the LAV-25. This was not unexpected since the vehicle, its turret systems and armament are essentially new and unfamiliar to the Marine Corps. Under the rubric of "essential subjects" or "general military" training presented to Marines at entry level, some training was identified which has applicability in concept or principle to the LAV-25 task groupings. For example, Marines are trained in day and night observations and surveillance techniques from a fixed location during recruit training. Refresher training is provided later during infantry skills training at ITS. In both environments this training is conducted in a stationary mode and without the use of precision optical devices. These skills are a far cry from what the LAV student will experience in a turret environment; nevertheless, the already acquired basic principles and techniques of observation and surveillance will facilitate and enhance like training in the LAV-25 environment. Similarly, Marines at recruit training and ITS receive extensive training in the service rifle, the 5.56mm M16A1. Through this training Marines become thoroughly knowledgeable about the rifle

and also, learn concepts and terminology which are generic to nearly all weapons they will encounter in their careers. Such concepts and terms include the following:

- Failure to fire
- Failure to feed
- Misfire
- Immediate action
- Cycle of operation
- Rates of fire
- Bolt assembly
- Barrel
- Receiver
- Buffer
- Flash suppressor

While these concepts and terms apply directly to the M16A1, they are generic in nature making them part of the language of weapons. Their knowledge, therefore, will facilitate and enhance the training of LAV-25 personnel in the vehicle's specific armament. Table 3-6 displays an overview of several task areas showing where existing entry level infantry training has application to the LAV-25 either directly or in principle or concept.

3.4.1.2 ITS Advanced Course. Unit leaders entering this course have considerably advanced entry level skills over those of the target populations discussed in ITS basic LAV and those entering the unit for the first time. These Marine have had 1-2 years in the unit and are Corporals or Sergeants. Therefore, any training device to be used would require a high degree of fidelity if any refinement of turret operation/maintenance skills is to take place.

3.4.1.3 Officer LAV Training. The entry level skills of the LAV officer can be assumed to range from very basic to fairly advanced in terms of an understanding of gunnery. Since this course is the least defined and since the objectives developed will, by necessity, be general in nature, it will be

TABLE 3-6. OVERVIEW OF ENTRY LEVEL TRAINING  
APPLICABILITY TO THE LAV-25

MAJOR MISSION ORIENTED, LAV-25 TURRET TASK GROUPINGS	ENTRY LEVEL TASK AREA TRAINING DESCRIPTIONS/ REMARKS	WHERE TRAINING OCCURS		APPLIES DIRECTLY TO LAV-25	APPLIES IN PRINCIPLE/ CONCEPT TO LAV-25
		Recruit Trng	ITS		
1. CONDUCT PLANNING	<ul style="list-style-type: none"> <li>Format, content and principles of delivery of the Five Paragraph Order</li> </ul>	X	X	X	
5. PERFORM TARGET ACQUISITION	<ul style="list-style-type: none"> <li>Conduct day/night surveillance and observations from fixed location without optics. Using 50 meter search method for day observation.</li> </ul>	X	X		X
	<ul style="list-style-type: none"> <li>Reporting information using the SALUTE method.</li> </ul>	X	X	X	
6. EMPLOY WEAPON SYSTEM	<ul style="list-style-type: none"> <li>Estimate ranges of stationary personnel, equipment, and vehicles partially or fully exposed at ranges from 50 to 3000 meters during daylight where all objects are visible. This training is normally done without precision optics and from fixed location on the ground.</li> </ul>	X	X		X

TABLE 3-6. OVERVIEW OF ENTRY LEVEL TRAINING  
APPLICABILITY TO THE LAV-25  
(continued)

MAJOR MISSION ORIENTED, LAV-25 TURRET TASK GROUPINGS	ENTRY LEVEL TASK AREA TRAINING DESCRIPTIONS/ REMARKS	WHERE TRAINING OCCURS		APPLIES DIRECTLY TO LAV-25	APPLIES IN PRINCIPLE/ CONCEPT TO LAV-25
		Recruit Trng	ITS		
	<ul style="list-style-type: none"> <li>Engage target with Light Anti-Tank Weapon (LAW). This engagement training is performed with a subcaliber LAW device. Targets are at ranges of 75 to 200 meters.</li> </ul> <p>Seven rounds are fired, three at a stationary target and four at a target moving 4 to 14 mph.</p>		X		X
2. CONDUCT PRE-OPERATION PROCEDURES	<ul style="list-style-type: none"> <li>Operation, firing, clearing, immediate action, disassembly, care and cleaning and assembly of M-16A1 5.56mm Rifle. In a general, but significant, way this thorough rifle training gives entry level Marines a knowledge base for enhancing understanding of various tasks/subtasks relative to the LAV-25 weaponry in the major task groupings at left.</li> </ul>	X	X		X
7. PERFORM IMMEDIATE ACTION PROCEDURES					
9. PERFORM PREVENTIVE MAINTENANCE					
10. PERFORM REMOVAL AND INSTALLATION PROCEDURES					
11. PERFORM OPERATOR TROUBLE-SHOOTING PROCEDURES					

assumed for the purposes of this study that any training devices utilized in the basic and advanced ITS LAV training will accomodate the required training for LAV officers.

3.4.1.4 Unit LAV Training. It is assumed that most Marines entering LAV units will have received basic LAV training. As discussed in Section 3.4.1.2, this training will familiarize the Marine with all the tasks contained in Appendix C. The unit will be required to provide additional practice to reinforce and refine those skills. In addition, the unit will be concerned with crew training as well as tactics of employment. Thus, all the tasks associated with gunnery training, turret operation and maintenance will be trained to develop a higher level of proficiency. Any training devices to be used in this environment should be able to accommodate individual skill reinforcement as well as crew training.

3.4.2 Tasks Requiring Training. In this section the results of the training task analysis are discussed with respect to the eleven mission-oriented task areas described in Section 2.3.2. These task areas are divided into two groups: (1) operator and (2) operator maintenance tasks. Figures 3-3 and 3-4 present all operator and operator maintenance tasks from the validated task list. All shaded tasks were found to require training. A complete listing of these tasks and their associated steps and substeps are found in Appendix E.

3.4.2.1 Operator Tasks Requiring Training. As shown in Figure 3-3, all but one of the 62 operator tasks identified for the LAV were determined to require training. This exception was the task, "Receive/Issue 5 Paragraph Order." This task is a member of the "Conduct Planning" task group. It was not identified as requiring training because it is an entry level task which is taught during recruit training.

Finally, it was judged inappropriate to perform any additional analysis on two of the tasks included in the "Pre-Operation Procedures" group. These tasks were:

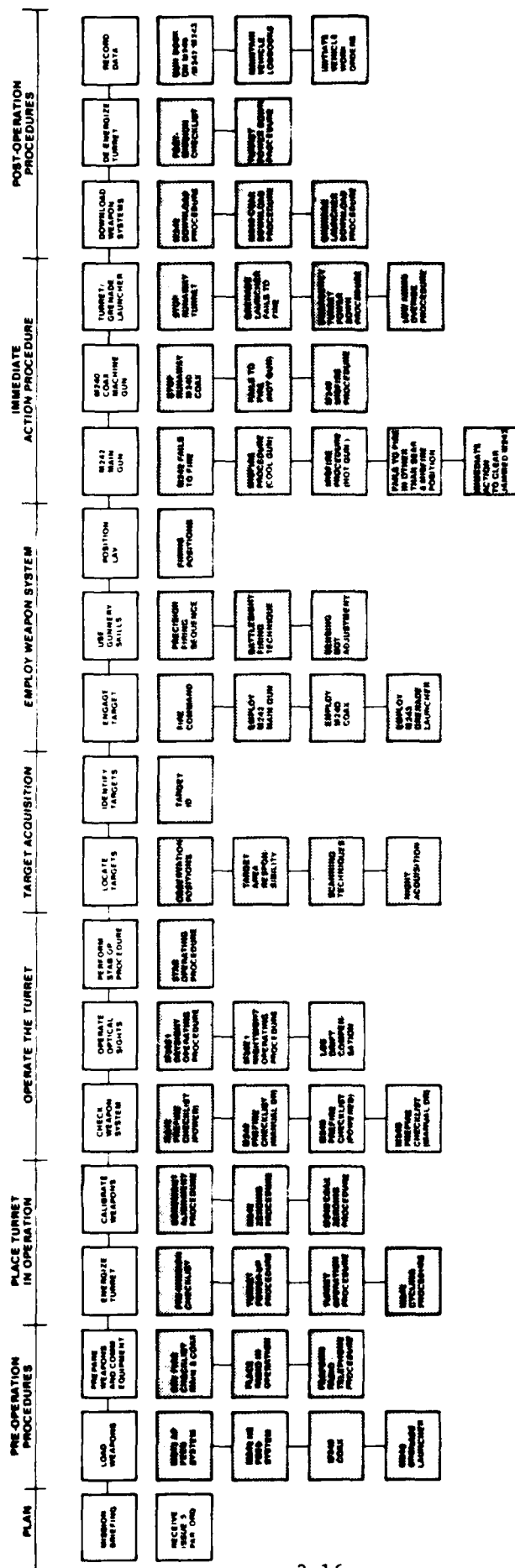


Figure 3-3. Operator Tasks Requiring Training.



3-17



- Place radio in operation.
- Perform radio telephone procedure.

The reason for this decision was that the specific radio that will be used in the LAV has not yet been determined.

3.4.2.2 Operator Maintenance Tasks Requiring Training. As shown in Figure 3-4, every operator maintenance task was determined to require training. There are a total of 25 different tasks encompassing the three groups of operator tasks: (1) Perform preventive maintenance; (2) Perform removal and installation procedures; and (3) Perform operator troubleshooting. Since nearly every task is new to the Marines, it is not surprising that all of the operator maintenance tasks will require some degree of formal training.

3.4.3 Hands-On Training Tasks. The results of the analysis of tasks requiring hands-on training are presented in Figures 3-5 and 3-6. As shown in these figures, nearly all operator and operator maintenance tasks require hands-on training.

3.4.3.1 Operator Hands-On Training Tasks. The analysis identified six tasks that did not require hands-on training (see Figure 3-5). Three of these tasks are members of the Perform Target Acquisition task group, and three involve Perform Post-Operation Procedures tasks. The three Target Acquisition tasks are: (1) Select/Occupy Observation Positions; (2) Assign Target Area Responsibility; and (3) Scan for Targets. These tasks mainly comprise tactical consideration and cognitive processes that are not likely to be enhanced by a training device. Additionally, those sub-tasks that do not require cognitive processes per se, are so simple that use of a training device is judged not to be warranted. The same can be said about the tasks concerned with post-operative procedures. These tasks are: (1) Maintain Weapons Record Data/Gun Book on M242/M240/M257; (2) Maintain and Validate Logbook; and (3) Initiate Vehicle Work Orders. At the institutional level, students will be provided classwork and demonstrations on the correct procedure to perform these and all other tasks not requiring hands-on training.



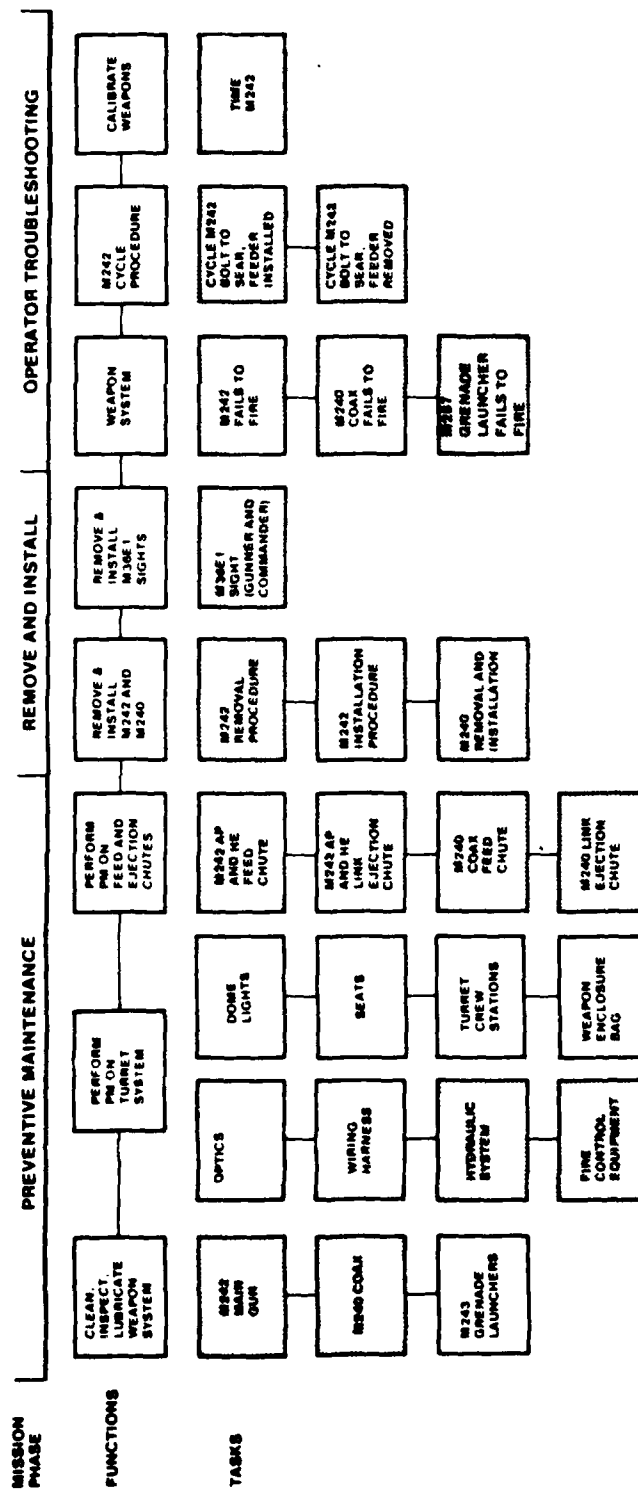


Figure 3-6. Operator Maintenance Hands-On Training Tasks.

3.4.3.2 Operator Maintenance Tasks Requiring Hands-On Training. As illustrated in Figure 3-6, the only tasks identified as not requiring hands-on training were tasks falling into the "Perform Preventive Maintenance (PM)" task group. The specific tasks concerned with Preventive Maintenance that did not require hands-on training were:

- Perform PM on M257 Grenade Launcher
- Perform PM on Optics
- Perform PM on Wiring Harnesses
- Perform PM on Dome Lights
- Perform PM on Seats
- Perform PM on Turret Crew Stations
- Perform PM on Weapon Enclosure Bag

The decision for excluding these tasks for hands-on training was made on data obtained from Marine Corps SMEs using the established selection criteria for hands-on training tasks as a guideline. The tasks identified as not requiring hands-on training will be taught at the institution via demonstration of the task. No hands-on training requirements have been identified for the specific preventive maintenance tasks mentioned previously. Any hands-on training that would occur would be provided through QJT from interaction with the actual equipment.

### 3.5 Training Media Alternatives

As discussed in Section 2.5, media alternatives were derived for LAV HOT tasks via a three step process. First, hardware fidelity requirements were described with respect to the stimulus presentation, response, and feedback features of the actual equipment. Next, the media attributes associated with these features were derived. Finally, these attributes were evaluated against the capabilities of state-of-the-art, generic training equipment. The remainder of this section provides the results of this three step process.

3.5.1 Hardware Fidelity Requirements. The product of the first step of the media analysis process was a description of the physical and functional fidelity requirements for each step/activity comprising the LAV HOT tasks.

This information constituted the baseline data for the remaining steps in the analysis process. Because of the sheer volume of data produced during this first analysis step, the complete data set has been bound together and is available on request.

Using the results of the hardware fidelity analysis, media attributes for all HOT tasks were summarized into the following categories:

- Equipment component characteristics
- Software based functionality
- Visual/Aural based feedback

3.5.2 Media Attributes. As noted in Section 2.5, in media attributes, the LAV HOT tasks were first grouped into related learning categories based on one or more of the following criteria:

- Use of common equipment
- A natural beginning-to-end sequence was formed by the tasks
- Task learning was based on a "common core" of the skills and knowledge

Six categories of LAV HOT tasks were identified.

- Maintenance Actions
- Immediate Actions
- Ammo Handling
- Turret Operations
- Gunnery Skills
- Boresight Alignment

These are summarized in Table 3-7 in terms of specific types of student actions in each category. As shown in Table 3-5, the Maintenance Actions and Immediate Actions categories generally involved performing the same kinds of tasks. These were of two types: (1) tasks involving specific types of interaction with equipment items; and (2) tasks performed in accordance with some constraint (e.g., according to a checklist, in a restricted space, or

TABLE 3-7. RELATED LEARNING CATEGORIES FOR LAV HOT TASKS

SUMMARY STUDENT ACTIONS	LEARNING CATEGORY					
	Maintenance Actions	Immediate Actions	Ammo Handling	Turret Operations	Gunnery Skills	Boresight Alignment
Perform tasks in accordance with checklist.	X	X	X	X		
Perform tasks in restrictive environment.	X	X	X			
Performs tasks with help of crew member.	X	X	X			
Locates, manipulates, and visually verifies controls and indicators.	X	X		X		
Disconnects connectors to equipment being removed.	X	X				
Un-Seats and seats equipment from rack/frame mount.	X	X				
Assembles/disassembles major equipment parts.	X	X				
Cleans and lubricates equipment.	X	X				
Performs troubleshooting procedures based on equipment status.	X	X				
Performs procedures within a time constraint.		X				
Uploads and downloads ammunition, observing proper safety handling procedures.			X			
Energizes turret equipment and monitors status.				X		
Manipulates turret controls and verifies associated movement.				X		
Listens for audio confirmation of turret hydraulic operation.				X		
Sets turret and weapon systems ready for fire in accordance with checklist.					X	
Maneuvers gun and turret manually with powered drive.					X	X
Interprets visual motion feedback via optical sights, periscopes, and open hatches.					X	
Identifies target; determines greatest threat; determines range, selects proper ammos and weapon; fires at target and uses proper fire command voice procedures.					X	
Interprets tracer and sensing feedback.					X	
Employs proper adjustment procedures to hit target.					X	
Identifies boresight target 1000M away through optical sight (gunner).						X
Installs boresighting rod (crewman).						X
Ensures gunner and crewman are looking at same target.						X
Adjusts optical sight reticle knobs.						X
Avoids any hull movement.						X

with the help of another individual). The basic difference between these two categories of tasks, however, was in terms of the time constraint imposed on task performance. Generally, performance of tasks in the Maintenance Actions category was not bound by any time constraint. In contrast, for the Immediate Actions task group, there were significant time constraints associated with task performance. The time constraints normally resulted from a requirement to place an inoperative item of equipment (using a weapon) back into service immediately in order to avoid compromising mission success.

Tasks in the Ammo Handling category were also divided into two types: (1) Those related to loading/unloading ammunition; and (2) those involving task performance under specific constraints (e.g., according to a checklist, in a restricted space, or with the help of another crew member). In this latter regard, the performance of the Ammo Handling tasks were very similar to those of the Maintenance and Immediate Actions categories.

In contrast to the categories just discussed, the Turret Operations, Gunnery Skills, and Boresight Alignment categories generally comprised tasks involving a crew member's interaction with specific controls and displays. Turret Operations tasks were mainly concerned with manipulating controls and observing individual equipment operation to verify its proper performance. Gunnery skills were concerned with the employment of LAV weapons (e.g., the main gun and coaxial machine gun) to engage and neutralize practice and battlefield type targets. Finally, Boresight Alignment tasks involved only the equipment and steps for the boresight alignment procedure.

Having partitioned the LAV HOT tasks into related learning categories, the next step in the analysis process was to derive specific media attribute requirements for each of these learning categories. This was done by applying the guidelines described in Tables 2-11, 2-12, and 2-13 to the hardware fidelity requirements for each task within each HOT task category. The results of this process are summarized in Table 3-8 for the media attribute categories:

TABLE 3-8. MEDIA ATTRIBUTES REQUIRED FOR TRAINING EQUIPMENT/DEVICES AS A FUNCTION OF LAV HOT LEARNING CATEGORIES

MEDIA ATTRIBUTE	LEARNING CATEGORY					
	MAINTENANCE ACTIONS	IMMEDIATE ACTIONS	AP40 HANDLING	TURRET OPERATIONS	GUNNERY SKILLS	BORESIGHT ALIGNMENT
Equipment Component Characteristics						
• Dimension	Most components 3D <sup>1</sup> ; Some 2D <sup>2</sup>	Most components 3D; Some 2D	Most components 3D; Some 2D	Some components 3D; Some 2D	Most components 3D; Some 2D	Most components 3D
• Size	Components generally same size as AC <sup>3</sup>	Components generally same size as AC	Components generally same size as AC	Components generally same size as AC	Components generally same size AC	Components generally same size as AC
• Relative Location	Assume same positions as AC	Assume same positions as AC	Assume same positions as AC	Assume same positions as AC	Assume same positions as AC	Assume same positions as AC
• Color	Same as AC	Same as AC	Same as AC	Same as AC	Same as AC	Same as AC
• Moving Mechanical Parts	Identical to AC	Identical to AC	Identical to AC Requirement	No specific Requirement	No specific	Identical to AC
• Weight	Replicate weight of heavy components	Replicate weight of heavy components	Replicate weight of heavy components	No requirement	No requirement	Boresight and adapter same weight as AC
Software Based Functionality	No requirement	No requirement	No requirement	Support functional fidelity of specific controls and indicators	Support functional fidelity of specific controls and indicators	No requirement
Visual/Aural Feedback	No requirement	No requirement	No requirement	Aural cues produced by AC as it is operated	Dynamic visual scenes similar to those provided on battlefield; audio sounds of AC and battlefield	No requirement

1 3D - Three dimensional

2 2D - Two dimensional

3 AC - Actual Component



- Equipment component characteristics
- Software-based functionality
- Visual/Aural feedback

As Table 3-8 shows, across all categories of LAV HOT tasks there was a media requirement to be able to replicate specific equipment components referenced by tasks in terms of:

- Dimension (usually three-dimensional)
- Size (generally the same size as an actual component)
- Relative location (same as actual component)
- Color (same as actual component)

Additionally, for the Maintenance Actions, Immediate Actions, Ammo Handling, and Boresight Alignment categories, there was a requirement to provide moving mechanical parts identical to the actual components referenced in the tasks comprising these categories. Also, there was a requirement for the weight of any replicated components to be the same as the actual component referenced by tasks in these categories.

Finally, for the Turret Operations and Gunnery Skills categories, media attribute requirements were identified for software based functionality, and visual/aural based feedback. With respect to software-based functionality a need was determined to exist to have specific controls and their indicators under the control of a software model which would reflect in real time the state of the turret and gunnery systems and any changes made to these systems as a consequence of system user control inputs or the failure of the user to make specific inputs within a specific period of time.

Finally, for Turret Operation tasks, a requirement was determined to exist to provide the aural cues normally produced during equipment operations. This would give students the feedback required to determine whether specific equipment components found in the turret were properly working, had failed, or were in the process of failing. A similar aural cue requirement was determined to exist for the Gunnery Skill task category. In addition, the need was also established for this latter category to provide

dynamic visual scenes to the gunner and vehicle commander to support the performance of firing tasks for all phases of LAV gunnery. A summary of anticipated types of visual scenes required to support LAV gunnery is provided in Table 3-9.

3.5.3 Media Alternatives. Given the above results, the final step in the media analysis process was to evaluate the capabilities of state-of-the-art, generic training devices/equipment to provide required media attributes. In making this evaluation, the objective was to identify devices/equipment that "would provide for efficient learning" without involving or incorporating any higher fidelity (i.e., extraneous media attributes) other than those absolutely required.

Tables 3-10 and 3-11 present the findings of this final step in the media analysis process. Table 3-10 presents the results for maintenance actions, immediate actions, ammo handling and boresight alignment HOT task categories. Table 3-11 presents the results of turret operations and gunnery skills HOT task categories. These two tables display in matrix form the media requirements and the capabilities of the training device/equipment alternatives. The result of this comparison is identification of alternatives providing minimal required fidelity capability which is indicated at the bottom of the matrix. A summary of these comparisons is provided in Figure 3-7. Of the five candidate training devices considered, two were found to provide the minimally required fidelity capability for supporting the learning of HOT tasks for the Maintenance Actions, Immediate Actions, Ammo Handling, and Boresight Alignment categories. These training device alternatives were a Procedures Trainer and a 3D Mock-Up. The major reason for judging that these media are the most appropriate ones for training HOT tasks in the Maintenance Actions, Immediate Actions, Ammo Handling, and Boresight Alignment categories is that either can provide the required media attributes for LAV components without providing unnecessary or added capability (e.g., software-based functionality and visual/aural-based feedback). Since more sophisticated capabilities are not required to support training in these areas, it follows that more sophisticated devices, like a dynamic model-based trainer, are not required. Further, because a large number of three-dimensional replicates of actual components are required to support

TABLE 3-9. PROSPECTIVE TARGET SCENE REQUIREMENTS FOR GUNNERY SKILLS

VEHICLE TO TARGET MOTION	TARGET TYPE	TARGET VISIBILITY	TARGET RANGE	AMMO	FIRE DELIVERY METHOD	RANGE DETERMINATION METHOD	WEAPON
Stationary to Stationary	Single	Night	Minimum	AP	Battle- Sight	Stadia	Maingun
Stationary	Multiple	Dawn/Dusk	Battle- Sight	HE	Precision	Coax w/Tracer	Coax
Stationary to Moving	Pure	Day	Weapon Effect- iveness	TPT		Commander's Estimate	Pintle Mounted Weapon
Moving to Moving	Mixed	Obscuration		7.62			
Moving to Stationary	Friendly			Grenades		AN/GVS-5	
	Enemy						

TABLE 3-10. SUMMARY OF MEDIA REQUIREMENTS/TRAINING MEDIA ANALYSIS FOR MAINTENANCE ACTIONS, IMMEDIATE ACTIONS, AMMO HANDLING, AND BORESIGHT ALIGNMENT TASK CATEGORIES

MEDIA REQUIREMENTS	TRAINING DEVICE/EQUIPMENT ALTERNATIVES <sup>1</sup>					Actual Equipment
	Dynamic Model	2D/3D Panel Trainer	Procedures Trainer	3D Mock-Up		
COMPONENT CHARACTERISTICS <sup>2</sup>						
● Most components 3D; some 2D <sup>3</sup>	Replicate/AC <sup>5</sup>	Usually 2D; some 3D	Replicate/AC	Replicate/AC	Replicate/AC	AC
● Generally same size as AC <sup>4</sup>	Replicate/AC	Replicate	Replicate/AC	Replicate/AC	Replicate/AC	AC
● Assume same relative locations/positions as AC	Replicate/AC	Depends on Design	Replicate/AC	Replicate/AC	Replicate/AC	AC
● Same color as AC	Replicate/AC	Replicate	Replicate/AC	Replicate/AC	Replicate/AC	AC
● All moving mechanical parts identical to AC	Replicate/AC	Depends on Design	Replicate/AC	Replicate/AC	Replicate/AC	AC
● Replicate weight of AC	Replicate/AC	Replicate	Replicate/AC	Replicate/AC	Replicate/AC	AC
SOFTWARE BASED FUNCTIONALITY						
● No requirement	Always provided	Usually provided	Optional	None	Not Applicable	
VISUAL/AURAL BASED FEEDBACK						
● Static visual requirement for boresight alignment only	Typically provided	Depends on Design	Optional	Optional	All visual and aural feedback normally associated with system	
ALTERNATIVE PROVIDING MINIMAL REQUIRED FIDELITY CAPABILITY	-	-	Y	Y	Y	Y

<sup>1</sup> NOTE: Actual equipment with a substitution firing device was not considered for training for this analysis since the task categories under considerations involved non-firing tasks.

<sup>2</sup> 3D = Three dimensional

<sup>3</sup> 2D = Two dimensional

<sup>4</sup> AC = Actual Equipment Component

<sup>5</sup> Replicate = A facsimile of an actual component

TABLE 3-11. SUMMARY OF MEDIA REQUIREMENTS/TRAINING MEDIA ANALYSIS FOR  
TURRET OPERATIONS AND GUNNERY SKILLS TASK CATEGORIES

MEDIA REQUIREMENTS	I TRAINING DEVICE/EQUIPMENT ALTERNATIVES					
	Actual Equipment with Substitute Firing Device	Dynamic Model	2D/3D Panel Trainer	Procedures Trainer	3D Mock-Up	Actual Equipment
COMPONENT CHARACTERISTICS						
1 • Most components 3D; some 2D	AC	4 Replicate/AC	Usually 2D; some 3D	Replicate/AC	Replicate/AC	AC
3 • Generally same size as AC	AC	Replicate/AC	Replicate	Replicate/AC	Replicate/AC	AC
• Assume same relative locations/positions as AC	AC	Replicate/AC	Depends on Design	Replicate/AC	Replicate/AC	AC
• Same color as AC	AC	Replicate/AC	Replicate	Replicate/AC	Replicate/AC	AC
SOFTWARE BASED FUNCTIONALITY						
• Software is required to support the functional fidelity of specific controls/indicators	Sometimes a part of subst. firing device	Always provided	Usually provided	Optional	None	Not Applicable
VISUAL/AURAL BASED FEEDBACK						
• Aural cues to reflect equipment operation	Only aural cues provided as part of system oper.	Typically provided	Depends on Design	Optional	Only visual & aural cues intrinsic to components	All visual and aural feedback normally associated with system
• Dynamic visual scenes to support Gunnery Skills tasks only	Sometimes a part of subst. firing device	Typically provided	Depends on Design	Optional	Only visual & aural cues intrinsic to components	All visual and aural feedback normally associated with system
ALTERNATIVE PROVIDING MINIMAL REQUIRED CAPABILITY	5 G	6 T, G	T	G	-	T, G

1 3D - Three dimensional

2 2D - Two dimensional

3 AC - Replicate

4 Replicate - A facsimile of an actual component

5 G - Gunnery Skills training supported

6 T - Turret Operations training supported

B - BASIC  
 A - ADVANCED  
 O - OFFICERS  
 U - UNIT

TASK CATEGORIES		AE	AE + SUB F.D.	DYN MOD	2D/ 3D	PT	3D M/U
MAINTENANCE ACTIONS	B	x				x	x
	A	x				x	x
	O	x				x	x
	U	x				x	x
AMMO HANDLING	B	x				x	x
	A	x				x	x
	O	x				x	x
	U	x				x	x
IMMEDIATE ACTIONS	B	x				x	x
	A	x				x	x
	O	x				x	x
	U	x				x	x
GUNNERY SKILLS	B	x		x	x	x	
	A	x	x	x	x		
	O	x	x	x	x		
	U	x	x	x	x		
TURRET OPERATIONS	B	x		x	x		
	A	x		x	x		
	O	x		x	x		
	U	x		x	x		
BORESIGHT ALIGNMENT	B	x				x	x
	A	x				x	x
	O	x				x	x
	U	x				x	x

Figure 3-7. Media Alternatives for Each HOT Task Category.

training, a 2D/3D panel trainer will not be adequate to support instruction. This derives from the fact that most 2D/3D panel trainers represent rather replicate equipment components, depending heavily on the use of graphics, pictures, and text messages to support training. Finally, Actual Equipment with a Substitute Firing Device is inappropriate here since this equipment/device combination is employed only to support training for gunnery/weapons firing. However, it should be noted that the use of actual equipment should be an acceptable medium for supporting training to the extent that sufficient LAV vehicles are procured to make one or more available for training or that the specific tasks to be practiced in the Maintenance Actions, Immediate Actions, Ammo Handling, or Boresighting Alignment categories can be performed safely without a significant likelihood of damage to either equipment or personnel.

For the Turret Operations and Gunnery Skills task categories, the media analysis revealed that dynamic model-based training devices can support the training of HOT tasks in these areas (see Table 3-11). For example, if a dynamic model-based system were developed for Gunnery Skills tasks (including a capability to present dynamic visual scenes in support of weapons firing), this system would necessarily completely support training in the practice and learning of Turret Operations skills since these mainly involve the operation of specific turret controls and their related indicators (lights, dials, gauges, etc.).

For training just Turret Operation skills, not only will a dynamic model-based system support the instructional process, but also, so will a 2D/3D Panel Trainer. In the case of the panel trainer, while all functionality is provided and mediated by software means, only critical components are likely to be fully and faithfully replicated with less important components being represented by two-dimensional simulates. Non-operational or irrelevant components can be expected to be represented using pictures or graphics. However, using text messages in conjunction with pictures and graphics (provided via slide projection, video tape, or video disc means), the same training can be accomplished with the panel trainer system to the same levels of effectiveness as is typically achieved with dynamic model-based systems.

Finally, for training just Gunnery Skills, at least two media other than a dynamic model-based system will do the job: 1) Actual Equipment with a Substitute Firing Device; and 2) a Procedures Trainer. As can be noted, the B, A, O and U reflect the four training environments in ITS courses and unit course. The basic course, because of the general nature of the instruction, would not require the type of devices in the advanced course and the unit courses. There is an advantage to the first of these alternatives in that the actual equipment can be exercised at unit or institutional level gunnery facilities with firing tasks being mediated by the substitute firing device. In this way, a large part of the learning environment (including vehicle controls and indicators) faithfully replicates the real world environment, thus potentially leading to maximum training transfer. The only caveat here is that the empirical evidence clearly indicates that moving from training with a substitution device to live firing normally requires some time for crew members to transition. Typically, their initial firing performance may be less than desired until they have adapted to the realities of the live firing process.

These problems of transition can frequently be reduced in severity or complexity if gunnery practice is supported by a procedures trainer which replicates the fire control system and incorporates important visual and aural cues typically produced during gunnery training and qualification. For example, this is an especially useful tool when recoil, blast and noise effects are appropriately represented in the trainer. The procedures trainer has the further advantage of providing all required controls and indicators functionally with a minimum of software. Where visual scenes are needed, simple scenes can be presented on monochrome monitors. These scenes can be designed to present simplified targets designed to move in ways similar to real world targets, thus providing the novice student with opportunities to practice the perceptual motor skills involved in target acquisition, tracking, and firing. For these reasons a procedures trainer represents a potentially useful way to support the training of basic LAV gunnery skills.



APPENDIX A

SAMPLE MANPOWER AND TRAINING RESEARCH INFORMATION SYSTEM (MATRIS)  
AND DEFENSE TECHNICAL INFORMATION CENTER (DTIC) WORK UNIT SEARCHES

\*\*\*\*\*

MATRIS # 200302 CONTROL # DA644458 WORK UNIT # A77704003

WORK UNIT TITLE:

SIMULATION CHARACTERISTICS FOR ARMOR SYSTEMS

RESPONSIBLE ORGANIZATION:

ARMY RESEARCH INST

PERFORMING ORGANIZATION:

ARMY RESEARCH INST

PRINCIPAL INVESTIGATOR: BESSEMER D

PHONE (COMMIAUTOVON): 502-624-4932/NE

SYNOPSIS/PURPOSE:

PROJECT SIMULATION TECHNOLOGY REQUIRED BY ARMOR TRAINING AND OPERATIONAL STRATEGIES. USE BEHAVIORAL ANALYZES OF CRITICAL COMBAT OPERATIONAL TASKS TO PROJECT TRAINING AND SIMULATOR REQUIREMENTS FOR TARGET ACQUISITION AND TANK GUNNERY; USE JUDGEMENTS OF HUMAN OBSERVERS TO EVALUATE THE VISUAL DISPLAY OF A PROTOTYPE CONDUCT OF PIPE TRAINER WITH RESPECT TO ITS REPRESENTATION OF INFORMATION CRITICAL TO MOVING TARGET GUNNERY, AND AN OPTIMAL STRATEGY FOR LEADING MOVING TARGETS.

PROGRESS MADE:

COMPLETED EFFORT; PREPARED REPORT; PREPARED PAPER AND PRESENTED IT AT THE NAVAL TRAINING AND EQUIPMENT CENTER CONFERENCE IN NOV79.

FUTURE DIRECTIONS/MILESTONES:

NE

PAYOFFS/UTILIZATION:

PROJECTION OF TRAINING AND SIMULATOR REQUIREMENTS FOR TARGET ACQUISITION AND TANK GUNNERY.

RESEARCH PRODUCTS:

REPORT: 'EVALUATION OF A GUNNERY SIMULATOR'S VISUAL DISPLAY, AND SEVERAL STRATEGIES FOR LEADING MOVING TARGETS'. PAPER: 'SOME CRUCIAL PROBLEMS IN TRAINING TANK GUNNERY SKILLS'.

START DATE: OCT 77 END DATE: SEP 79 STATUS: COMPLETED

\*\*\*\*\*

UNCLASSIFIED  
DTIC REPORT NO. CY2734 JUN 03, 1983  
DTIC FORMAT B0078

TITLE: (U) TANK GUNNERY TRAINING DEVICES MIXES (ADV DEV)

PERFORMING ORGANIZATION DA ARI FT KNOX FIELD UNIT -  
SIMULATION SYSTEMS TEAM FT KNOX  
KY 40121

RESPONSIBLE GOVT ORGANIZATION  
DA ARI FT KNOX FIELD UNIT  
STEELE HALL FT KNOX KY 40121

PRINCIPAL INVESTIGATOR BESSEMER, D W  
ASSOCIATE INVESTIGATOR KOTTAS, B L

TELEPHONE NUMBER 5026244932  
CONTRACT/GRANT NUMBER

PERFORMANCE METHOD IN-HOUSE  
CONTRACT/GRANT AMOUNT \$ 0

DATE OF SUMMARY 30 SEP 82  
START DATE OCT 81  
ESTIMATED COMPLETION DATE CONT

KIND OF SUMMARY TERMINATED  
SUMMARY SECURITY UNCLASSIFIED  
WORK SECURITY UNCLASSIFIED

SCIENTIFIC AND TECHNOLOGICAL AREAS  
012500 PERSONNEL SELECTION TRAINING AND EVALUATION  
013400 PSYCHOLOGY (INDIVIDUAL AND GROUP BEHAVIOR)  
009400 MAN-MACHINE RELATIONS

PROGRAM ELEMENT: PROJECT NO: TASK NUMBER:  
83743A 2Q283743A794 3380

KEYWORDS: (U) ARMY TRAINING (U) TRAINING DEVICES (U) TANKS  
(COMBAT VEHICLES) (U) SIMULATORS (U) SIMULATION

DESCRIPTORS: (U) AMMUNITION (U) COMBAT VEHICLES (U) FIELD TESTS  
(U) GUNS (U) REDUCTION (U) SIMULATION (U) TRAINING (U)  
TRAINING DEVICES (U) WEAPONS (U) ARMY TRAINING (U) GUNNERY  
(U) TANKS (COMBAT VEHICLES) (U) PERFORMANCE (HUMAN) (U) GUNNERY  
TRAINERS (U) COST EFFECTIVENESS (U) TANK CREWS (U) SKILLS

IDENTIFIERS: (U) M-1 TANKS (U) M-80A1 TANKS (U) M-80A3 TANKS

OBJECTIVE: (U) TO DETERMINE PERFORMANCE STANDARDS AND AMOUNTS OF  
TRAINING NEEDED ON ALTERNATIVE COMBINATIONS OF TRAINING DEVICES TO

REPORT NO. CY2734 UNCLASSIFIED PAGE 13

UNCLASSIFIED  
DTIC REPORT NO. CY2734 JUN 03, 1983  
DTIC FORMAT B0078

TO COMPENSATE FOR REDUCED MAIN GUN AMMUNITION, WHILE MAINTAINING  
OR INCREASING TANK GUNNERY PERFORMANCE, RESULTS WILL BE USED TO  
RECOMMEND COST-EFFECTIVE DEVICE COMBINATIONS SUPPORTING TANK  
GUNNERY TRAINING IN INSTITUTIONAL, UNIT, RESERVE, AND  
MOBILIZATION SETTINGS. TANK GUNNERY TRAINING USING ADVANCED  
COMPUTERGRAPHIC AND VIDEO/CDSC TECHNOLOGIES WILL BE ASSESSED.

APPROACH: (U) PREVIOUS ANALYSES OF DEVICE CAPABILITY WILL BE  
COMBINED AND EXTENDED TO DETERMINE ALTERNATIVE DEVICES  
APPROPRIATE FOR GUNNERY PRACTICE IN PARTICULAR TRAINING PHASES  
FOR M80A1, M80A3, AND M1 TANKS. ALTERNATIVE DEVICES SUPPORTING  
EACH PHASE OF TRAINING WILL BE IDENTIFIED, AND TESTS OF CRITICAL  
SUBSKILLS WILL BE DEVELOPED FOR EACH PHASE TO PROVIDE A COMMON  
ASSAY OF SKILL ACQUISITION. USING SELECTED PHASES, CAUSAL PATH  
ANALYSIS WILL BE TESTED AS A METHOD OF DETERMINING THE COMBINED  
IMPACT OF DEVICES, AMOUNT OF TRAINING, AND SKILL LEVELS ACROSS  
SUCCESSIVE PHASES. THE METHODOLOGY WILL BE THEN USED TO DEVELOP  
MODELS PREDICTING THE COMBINED EFFECTIVENESS OF GUNNERY TRAINING  
DEVICES FOR EACH TANK, AND FOR VARIOUS SETTINGS. TRAINING  
PROGRAMS WILL BE DESIGNED AND DEVELOPED FOR THE USE OF PROTOTYPE  
PART-TASK DEVICES (PERCEPTRONICS AND ATARI) IN INSTITUTIONAL  
TRAINING. FIELD TRIALS WILL BE CONDUCTED TO ASSESS THE  
EFFECTIVENESS OF EACH DEVICE.

RESOURCE ESTIMATED (FUNDS IN THOUSANDS) CFY 0  
CFY-1 180

CONTRACTOR ACCESS: YES ACCESSION NUMBER: DA0G7830

PROCESSING DATE: 31 MAR 83

REPORT NO. CY2734 UNCLASSIFIED PAGE 13 A

# APPENDIX B

## SUMMARY LIST OF DTIC DOCUMENTS ORDERED FROM GUNNERY AND TRAINING TECHNICAL REPORT SEARCHES

REPORT TITLE	AD NUMBER
1. Training Materials and Data Requirements for the Combat Training (CTT) Training Test Support Plan	A 125 378
2. Design Institutional and Unit Sustainment Training Programs for XM1 Armor Crewman	A 125 429
3. Development of Training Objectives for XM1 U-COFT	A 125 757
4. Prototype Crew Drills Training Program for XM1 Tank Gunnery	A 078 499
5. Mini Tank Hit Detection System	A 101 484
6. Trainer Engineering Report (Final) for MILES	A 102 276
7. Military Weapons Simulators Utilizing Visible Wavelength Lasers	A 042 120
8. The Armor Development Plan, Volume II: Training	A 076 910
9. Anti-Armor Weapon Trainer	D 009 167
10. Laser Helicopter Gunner Trainer	A 024 836
11. Training for IFV-M2: An Evaluation of the 11M10 Course	A 109 407
12. Weapons Training Apparatus for Simulating Long Range Weapons	D 007 920
13. Evaluation of a New Approach to Target Acquisition Training	A 111 732
14. Evaluation of Two Tank Gunnery Trainers	A 082 954
15. Stabalized Gunnery Training Techniques	P 000 875
16. Training Transfer from Mini-Tank Range to Tank Main Gun Firing	A 061 566
17. Evaluation of a Gunnery Simulator's Visual Display and Several Strategies for Leading Moving Targets	A 086 459
18. Mastery Training: Effect on Skill Retention	A 120 762

APPENDIX B

SUMMARY LIST OF DTIC DOCUMENTS ORDERED  
FROM GUNNERY AND TRAINING TECHNICAL REPORT SEARCHES

Continued

REPORT TITLE	AD NUMBER
19. Field Survey of Current Practices and Problems in Army Unit Training With Implications for Fielding and Training with the MILES, Volumes I & II	A 128 479
20. Armored Fighting Vehicles Identification Training: A New Perspective	P 000 845
21. Training Materials and Data Requirements for Unit Conduct of Fire Trainer (U-COFT) Training Test Support Plan	A 125 673

APPENDIX C  
VALIDATED LAV-25 TASK LIST

1. CONDUCT PLANNING

1.1 RECEIVE AND/OR ISSUE FIVE PARAGRAPH ORDER

2. PERFORM PRE-OPERATION PROCEDURES

2.1 PERFORM M242 MAIN GUN AP FEED SYSTEM LOADING PROCEDURE

2.2 PERFORM M242 MAIN GUN HE FEED SYSTEM LOADING PROCEDURE

2.3 PERFORM M240 COAX LOADING PROCEDURE

2.4 PERFORM M257 GRENADE LAUNCHER LOADING PROCEDURE

2.5 PERFORM DRY FIRE CHECKLIST (M242 MAINGUN AND M240 COAX) PROCEDURE

2.6 PLACE RADIO IN OPERATION

2.7 PERFORM RADIO TELEPHONE PROCEDURES

3. PLACE TURRET IN OPERATION

3.1 PERFORM PRE-MISSION CHECKLIST PROCEDURE

3.2 PERFORM TURRET POWER-UP PROCEDURE

3.3 PERFORM TURRET OPERATION PROCEDURES

3.4 PERFORM M242 MAIN GUN CYCLING PROCEDURE

3.5 PERFORM M242 MAIN GUN BORESIGHT PROCEDURE

3.6 PERFORM M242 MAIN GUN ZEROING PROCEDURE

3.7 PERFORM M240 COAX BORESIGHT PROCEDURE

4. OPERATE THE TURRET

4.1 PERFORM M242 MAIN GUN PRE-FIRE CHECKLIST PROCEDURES (POWERED DRIVE)

4.2 PERFORM M242 MAIN GUN PRE-FIRE CHECKLIST PROCEDURES (MANUAL DRIVE)

4.3 PERFORM M240 COAX PRE-FIRE CHECKLIST PROCEDURES (POWERED DRIVE)

4.4 PERFORM M240 COAX PRE-FIRE CHECKLIST PROCEDURES (MANUAL DRIVE)

4.5 PERFORM STAB OPERATING PROCEDURE

4.6 PERFORM M36E1 DAYSIGHT OPERATING PROCEDURE

- 4.7 PERFORM LOS DRIFT COMPENSATION PROCEDURE
- 4.8 PERFORM M30E1 NIGHTSIGHT OPERATING PROCEDURE

5. PERFORM TARGET ACQUISITION

- 5.1 SELECT/OCCUPY OBSERVATION POSITIONS
- 5.2 ASSIGN TARGET AREA RESPONSIBILITIES
- 5.3 SCAN FOR TARGETS
- 5.4 PERFORM NIGHT ACQUISITION
- 5.5 SCAN FOR TARGET IDENTIFICATION

6. EMPLOY WEAPON SYSTEM

- 6.1 ISSUE INITIAL FIRE COMMAND
- 6.2 PERFORM PRECISION FIRING SEQUENCE
- 6.3 APPLY BATTLESIGHT FIRING TECHNIQUE
- 6.4 PERFORM SENSING AND BURST ON TARGET ADJUSTMENT
- 6.5 ENGAGE TARGETS WITH M242 MAIN GUN
- 6.6 ENGAGE TARGETS WITH M240 COAX MACHINE GUN
- 6.7 EMPLOY M257 GRENADE LAUNCHER
- 6.8 SELECT AND OCCUPY FIRING POSITIONS

7. PERFORM IMMEDIATE ACTION PROCEDURES

- 7.1 STOP RUNAWAY TURRET
- 7.2 REDUCE M242 MAIN GUN FAILURE TO FIRE
- 7.3 PERFORM M242 MAIN GUN MISFIRE PROCEDURE (COOL GUN)
- 7.4 PERFORM M242 MAIN GUN MISFIRE PROCEDURE (HOT GUN)
- 7.5 PERFORM SAFETY PROCEDURES WHEN HOT M242 MAIN GUN FAILS TO FIRE AND BOLT POSITION INDICATOR IN POSITION OTHER THAN SEAR AND MISFIRE
- 7.6 PERFORM IMMEDIATE ACTION TO CLEAR JAMMED MAIN GUN
- 7.7 STOP RUNAWAY M240 COAX
- 7.8 REDUCE M240 COAX GUN FAILURE TO FIRE (HOT GUN)
- 7.9 PERFORM M240 COAX MISFIRE PROCEDURE
- 7.10 REDUCE M257 GRENADE LAUNCHER FAILURE TO LAUNCH
- 7.11 PERFORM EMERGENCY TURRET POWER-DOWN PROCEDURE
- 7.12 PERFORM LOW AMMO OVERRIDE PROCEDURE

AD-A141 847

LIGHT ARMORED VEHICLE (LAV) TASK AND MEDIA ANALYSIS FOR  
THE US MARINE CORPS LAV-25(U) BAUM CHEMICAL CORP CARSON  
CALIF\* C FAGAN ET AL. 26 AUG 83 C731.08

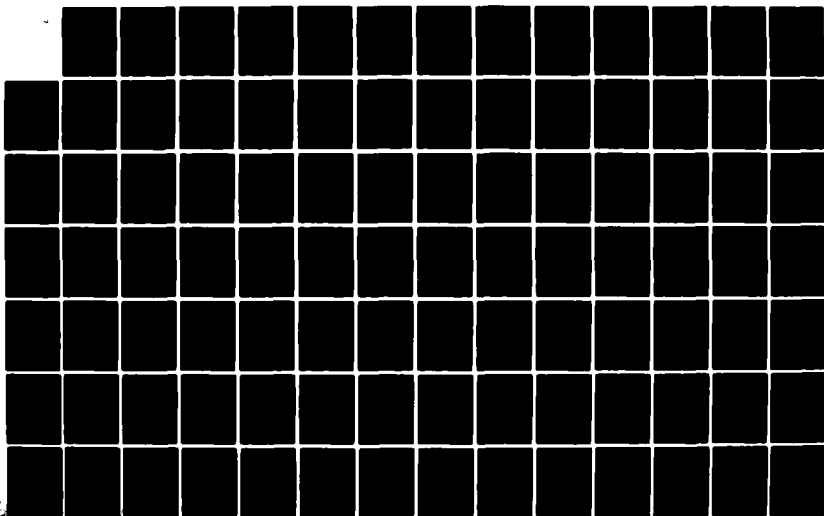
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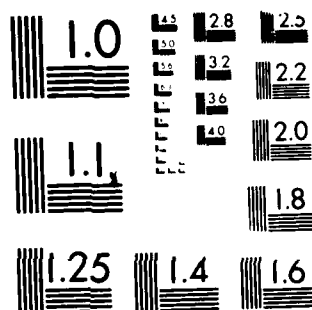
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8. PERFORM POST-OPERATING PROCEDURES

- 8.1 PERFORM M242 MAIN GUN DOWNLOADING PROCEDURE
- 8.2 PERFORM M240 COAX DOWNLOADING PROCEDURE
- 8.3 PERFORM M257 GRENADE LAUNCHER DOWNLOADING PROCEDURE
- 8.4 PERFORM TURRET POWER-DOWN PROCEDURE
- 8.5 PERFORM POST-MISSION CHECKLIST PROCEDURE
- 8.6 MAINTAIN WEAPONS RECORD DATA/GUN BOOK ON M240/M242/M257
- 8.7 MAINTAIN VEHICLE LOGBOOKS
- 8.8 INITIATE VEHICLE WORK ORDERS

9. PERFORM PREVENTIVE MAINTENANCE (PM)

- 9.1 CLEAN, INSPECT, LUBRICATE M242 MAIN GUN
- 9.2 CLEAN, INSPECT, LUBRICATE M240 COAX
- 9.3 PERFORM M257 GRENADE LAUNCHER PM
- 9.4 PERFORM PM ON OPTICS
- 9.5 PERFORM PM ON WIRING HARNESSSES
- 9.6 PERFORM PM ON HYDRAULIC SYSTEM
- 9.7 PERFORM PM ON FIRE CONTROL EQUIPMENT
- 9.8 PERFORM PM ON DOME LIGHTS
- 9.9 PERFORM PM ON SEATS
- 9.10 PERFORM PM ON TURRET CREW STATIONS
- 9.11 PERFORM PM ON WEAPON ENCLOSURE BAG
- 9.12 PERFORM PM ON M242 MAIN GUN AP AND HE FEED CHUTES
- 9.13 PERFORM PM ON M242 MAIN GUN AP AND HE LINK EJECTION CHUTES
- 9.14 PERFORM PM ON M240 COAX FEED CHUTE
- 9.15 PERFORM PM ON M240 COAX LINK EJECTION CHUTE

10. PERFORM REMOVAL AND INSTALLATION PROCEDURES

- 10.1 PERFORM M242 MAIN GUN REMOVAL PROCEDURE
- 10.2 PERFORM M242 MAIN GUN INSTALLATION PROCEDURE
- 10.3 PERFORM M240 COAX REMOVAL, DISASSEMBLY, ASSEMBLY AND INSTALLATION PROCEDURES
- 10.4 PERFORM M36E1 SIGHT (GUNNERS AND COMMANDERS) REMOVAL/INSTALLATION PROCEDURES

11. PERFORM OPERATOR TROUBLESHOOTING PROCEDURES

- 11.1 TROUBLESHOOT M242 MAIN GUN FAILURE TO FIRE
- 11.2 TROUBLESHOOT M240 COAX FAILURE TO FIRE
- 11.3 TROUBLESHOOT M257 GRENADE LAUNCHER FAILURE TO LAUNCH
- 11.4 CYCLE M242 BOLT TO SEAR, FEEDER INSTALLED
- 11.5 CYCLE M242 BOLT TO SEAR, FEEDER REMOVED
- 11.6 TIME M242

## MISSION ORIENTED LAV TURRET TASK LISTING

### 1. CONDUCT PLANNING

1.1 RECEIVE AND/OR ISSUE FIVE PARAGRAPH ORDER.

### 2. PERFORM PRE-OPERATION PROCEDURES

2.1 PERFORM M242 MAIN GUN AP FEED SYSTEM LOADING PROCEDURE.

2.1.1 Turn TURRET POWER circuit breaker OFF.

2.1.2 Verify TURRET PWR indicator not lit.

2.1.3 Turn TURRET DRIVE LOCK to LOCK position.

#### WARNING

Loading procedures requires working from inside of vehicle through the turret opening. To prevent injury to personnel or damage to equipment, ensure that TURRET POWER circuit breaker remains in OFF position and TURRET DRIVE LOCK remains at LOCK position while working through turret opening.

2.1.4 Turn WEAPON POWER circuit breaker OFF.

2.1.5 Verify WEAPON PWR indicator not lit.

2.1.6 Set WEAPON ARM switch to SAFE.

2.1.7 Place M242 manual safety on SAFE (crosswise).

2.1.8 Remove all links from the AP link chute.

2.1.9 Perform feeder removal and installation procedure and verify that the weapon is clear prior to loading ammunition.

2.1.10 Verify that both ends of AP feed chute are latched in place.

2.1.11 Verify that the bolt position indicator pointer is at SEAR.

2.1.12 Rotate knob on M242 vertical drive shaft back and forth to verify that the weapon bolt assembly is in SEAR. Drive shaft must meet resistance in both directions.

- 2.1.13 Push feed select solenoid on M242 to AP position (IN).
- 2.1.14 Open AP ammo box cover on forward compartment of ready box.
- 2.1.15 Load AP ammo into the ready box with the projectile toward the Commander's station.
  - 2.1.15.1 Put the double claw end of the belt into the forward section of the compartment (link face down) and fold the belt to fill the compartment.
- 2.1.16 Connect succeeding belts as needed.
- 2.1.17 Route the single-claw end of a belt into the forwarder with the link side up.
- 2.1.18 Use the 14mm ratchet wrench on the forwarder to route the ammo belt up the feed chute.
  - 2.1.18.1 Continue until the lead round is in the upper feed sprocket.
- 2.1.19 Place 14mm wrench on upper feed sprocket extension and rotate in direction of arrow on feeder until the feed chute stop clicks once.

NOTE

If unable to successfully accomplish 2.1.19, return wrench to forwarder and ensure lead round is in the upper feed sprocket.

- 2.1.20 Close AP ammo box cover and secure.
  - 2.1.21 Stow 14mm ratchet wrench.
  - 2.1.22 Verify that weapons enclosure bag is properly secured around weapons, feed chutes, and top of rotor.
  - 2.1.23 Set TURRET DRIVE LOCK to UNLOCK position.
  - 2.1.24 Sound alert "POWER." Position TURRET POWER and WEAPON POWER circuit breakers to ON.
  - 2.1.25 Verify TURRET PWR and WEAPON PWR indicators lit.
- 2.2 PERFORM M242 MAIN GUN HE FEED SYSTEM LOADING PROCEDURE.
- 2.2.1 Turn TURRET POWER circuit breaker OFF.
  - 2.2.2 Verify TURRET PWR indicator not lit.
  - 2.2.3 Turn TURRET DRIVE LOCK in LOCK position.

## WARNING

Loading procedures requires working from inside of vehicle through the turret opening. To prevent injury to personnel or damage to equipment, ensure that TURRET POWER circuit breaker remains in OFF position and TURRET DRIVE remains at LOCK position while working through turret opening.

- 2.2.4 Turn WEAPON POWER circuit breaker OFF.
- 2.2.5 Verif WEAPON PWR indicator not lit.
- 2.2.6 Position WEAPON ARM switch to SAFE.
- 2.2.7 Place M242 manual safety on SAFE (crosswise).
- 2.2.8 Remove all links from the HE link chute.
- 2.2.9 Perform feeder removal and installation procedure and verify that the weapon is clear prior to loading ammunition.
- 2.2.10 Verify that both ends of HE feed chute are latched in place.
- 2.2.11 Verify that the bolt position indicator pointer is at SEAR.
- 2.2.12 Rotate knob on M242 vertical drive shaft back and forth to verify that the weapon bolt assembly is in SEAR. Drive shaft must meet resistance in both directions.
- 2.2.13 Pull the feed select solenoid to HE position (OUT).
- 2.2.14 Remove HE ammo box cover from rear compartment of ready box.
- 2.2.15 Load HE ammo into the ready box with the projectile toward the Commander's station.
  - 2.2.15.1 Put the single-claw end of the belt into the forward compartment of the ready box. Fold the belt to fill that compartment (ammo face down). After the front compartment is full, fill the second and rear compartments in sequence.
- 2.2.16 Connect succeeding belts as needed.

- 2.2.17 Route the double-claw end of a belt, with a round in and link side up, into the forwarder.
- 2.2.18 Use the 14mm ratchet wrench on the forwarder to route the ammo belt up the feed chute.
  - 2.2.18.1 Continue until the lead round is in the lower feed sprocket.
- 2.2.19 Place 14mm wrench on lower feed sprocket extension and rotate in direction of arrow on feeder until the feed chute stop clicks twice.

NOTE

If unable to successfully accomplish 2.2.19, return wrench to forwarder and ensure lead round is in the upper feed sprocket.

- 2.2.20 Close HE ammo box cover and secure.
  - 2.2.21 Stow the 14mm ratchet wrench.
  - 2.2.22 Verify that weapons enclosure bag is properly secured around weapons, feed chutes, and top of rotor.
  - 2.2.23 Set TURRET DRIVE LOCK handle to UNLOCK position.
  - 2.2.24 Sound alert "POWER." Position TURRET PWR and WEAPON PWR circuit breakers to ON.
  - 2.2.25 Verify TURRET PWR and WEAPON PWR indicators lit.
- 2.3 PERFORM M240 COAX LOADING PROCEDURE.
- 2.3.1 Turn TURRET POWER circuit breaker OFF.
  - 2.3.2 Verify TURRET PWR indicator not lit.
  - 2.3.3 Turn TURRET DRIVE LOCK handle to LOCK.

## WARNING

Loading procedure requires working from inside of vehicle through turret opening. To prevent injury to personnel or damage to equipment, ensure that TURRET POWER circuit breaker remains in OFF position and TURRET DRIVE LOCK remains at LOCK position while working through turret opening.

- 2.3.4 Set WEAPON POWER circuit breaker to OFF position.
- 2.3.5 Verify WEAPON PWR indicator not lit.
- 2.3.6 Position WEAPON ARM switch to SAFE.
- 2.3.7 Charge M240, set weapon manual safety to S (safe) position.
- 2.3.8 Load 7.62mm ammo into front compartment of ammo box with projectile pointing outboard, double claw end of belt against forward wall of compartment, solid side of link down and round up.

## NOTE

Additional ammo belts will be connected, as needed, until ammo box is full.

- 2.3.9 Fold ammo belt back and forth until front compartment of ammo box is full, then fill center and rear compartments in sequence using same loading pattern.

## NOTE

If end of ammo belt from previous loading is folded over ammo forwarder, proceed to step 2.3.17.

- 2.3.10 Pull weapon charging handle to rear.
- 2.3.11 Push in cover latches and open weapon cover.
- 2.3.12 Raise feed tray.

- 2.3.13 Visually and physically inspect chamber to ensure that no round is chambered.
  - 2.3.14 Lower feed tray.
  - 2.3.15 Take an ammo belt that is not connected to ammo belts in ammo box and manually insert double claw end of belt (with solid side of link up and round down) into feedchute at forward end of ammo box.
  - 2.3.16 Manually slide belt through feed chute until first round reaches cartridge stop at weapon.
  - 2.3.17 Close weapon cover.
  - 2.3.18 Connect ammo belt in ammo box to end of ammo belt in ammo chute.
  - 2.3.19 Set weapon manual safety to F (Fire) position.
  - 2.3.20 Turn TURRET DRIVE LOCK to UNLOCK position.
  - 2.3.21 Sound alert "POWER." Turn TURRET POWER and WEAPON POWER circuit breakers to ON position.
  - 2.3.22 Verify TURRET PWR and WEAPON PWR indicators lit.
- 2.4 PERFORM M257 GRENADE LAUNCHER LOADING PROCEDURE.
- 2.4.1 Turn TURRET POWER circuit breaker OFF.
  - 2.4.2 Verify TURRET PWR indicator not lit.
  - 2.4.3 Turn TURRET DRIVE LOCK to LOCK position.
  - 2.4.4 Turn WEAPON POWER circuit breaker OFF.
  - 2.4.5 Verify WEAPON PWR indicator not lit.
  - 2.4.6 Turn LEFT SALVO switch OFF.
  - 2.4.7 Turn RIGHT SALVO switch OFF.
  - 2.4.8 Remove and store four protective covers from each launcher.
  - 2.4.9 Verify that each launcher barrel is free of contamination and contacts are clear.
  - 2.4.10 Insert a grenade in a barrel electrical contacts first.

#### WARNING

When loading L5 smoke grenades, keep your body, head, fingers, etc., out of the direct line of the barrel as the grenade is inserted.



- 2.4.11 Rotate the grenade at least a quarter turn to insure electrical contact.
- 2.4.12 Repeat steps 2.4.10 and 2.4.11 for remaining barrels.
- 2.4.13 Turn TURRET DRIVE LOCK to UNLOCK position.
- 2.4.14 Sound alert "POWER." Turn TURRET POWER and WEAPON POWER circuit breakers to ON position.
- 2.4.15 Verify TURRET PWR and WEAPON PWR indicators lit.
- 2.5 PERFORM DRY FIRE CHECKLIST (M242 MAIN GUN AND M240 COAX) PROCEDURE.
  - 2.5.1 Ensure appropriate vehicle hatches closed and locked.
  - 2.5.2 Place M242 safety to SAFE (crosswise).
  - 2.5.3 Charge M240, set weapon manual safety to S (Safe) position.
  - 2.5.4 Turn TURRET DRIVE LOCK to LOCK position.
  - 2.5.5 Sound alert "POWER"; set TURRET POWER, WEAPON POWER, and AUXILIARY POWER circuit breakers to ON position.
  - 2.5.6 Verify that TURRET PWR, WEAPON PWR and AUX PWR indicators are lit.
  - 2.5.7 Set WEAPON ARM switch to ARM.
  - 2.5.8 Position DRIVE SELECT lever up for power mode.
  - 2.5.9 Position gunner's MAIN/COAX switch to MAIN.
  - 2.5.10 Verify "MAIN" indicator lit.
  - 2.5.11 Verify MAIN GUN "SEAR" indicator lit.
  - 2.5.12 Position gunner's AP/HE switch to AP.
  - 2.5.13 Verify "AP" indicator lit.
  - 2.5.14 Push LOW AMMO OVERRIDE switch to ON.
  - 2.5.15 Position gunner's 200/100/SS switch to SS.
  - 2.5.16 Verify "SS" indicator lit.
  - 2.5.17 Squeeze gunner's palm switch.
  - 2.5.18 Lift trigger guard, squeeze gunner's trigger.
  - 2.5.19 Verify bolt position indicator at MISFIRE.
  - 2.5.20 Verify MISFIRE RESET WARNING indicator lit.
  - 2.5.21 Press MISFIRE RESET WARNING indicator.
  - 2.5.22 Lift trigger guard, squeeze gunner's trigger.
  - 2.5.23 Verify bolt position indicator at SEAR.
  - 2.5.24 Position gunner's AP/HE switch to HE.
  - 2.5.25 Verify HE indicator lit.
  - 2.5.26 Push LOW AMMO OVERRIDE switch to ON.

- 2.5.27 Lift trigger guard, squeeze gunner's trigger.
- 2.5.28 Verify bolt position indicator at MISFIRE.
- 2.5.29 Verify MISFIRE RESET WARNING indicator lit.
- 2.5.30 Press MISFIRE RESET WARNING indicator.
- 2.5.31 Lift trigger guard, squeeze gunner's trigger.
- 2.5.32 Verify bolt position indicator at SEAR.
- 2.5.33 Position gunner's MAIN/COAX switch to COAX.
- 2.5.34 Verify COAX indicator lit.
- 2.5.35 Position COAX manual safety to F (Fire).
- 2.5.36 Pull charging handle to rear and hold.
- 2.5.37 Lift trigger guard, squeeze gunner's trigger.
- 2.5.38 Slowly release charging handle and ride bolt forward.
- 2.5.39 Release gunner's palm switch.
- 2.5.40 Repeat steps 2.5.9 through 2.5.39 using Commander's hand control.
- 2.5.41 Position DRIVE SELECT lever down for manual mode.
- 2.5.42 Position gunner's MAIN/COAX switch to MAIN.
- 2.5.43 Verify MAIN indicator lit.
- 2.5.44 Position gunner's 200/100/SS switch to SS.
- 2.5.45 Verify SS indicator lit.
- 2.5.46 Push LOW AMMO OVERRIDE switch to ON.
- 2.5.47 Press auxiliary trigger on elevation handcrank.
- 2.5.48 Verify bolt position indicator at MISFIRE.
- 2.5.49 Verify MISFIRE RESET WARNING indicator lit.
- 2.5.50 Press MISFIRE RESET WARNING indicator.
- 2.5.51 Press auxiliary trigger on elevation handcrank.
- 2.5.52 Verify bolt position indicator at SEAR.
- 2.5.53 Position gunner's MAIN/COAX switch to COAX.
- 2.5.54 Verify COAX indicator lit.
- 2.5.55 Push LOW AMMO OVERRIDE switch to ON.
- 2.5.56 Pull charging handle to rear and hold.
- 2.5.57 Press auxiliary trigger on elevation handcrank.
- 2.5.58 Slowly release charging handle and ride bolt forward.
- 2.5.59 Pull the COAX charging handle to the rear and hold.
- 2.5.60 Pull COAX manual trigger.
- 2.5.61 Slowly release charging handle and ride bolt forward.

2.5.62 Repeat steps 2.5.42 through 2.5.61 using commander's hand control.

2.5.63 Charge COAX and position manual safety to S (Safe).

2.6 PLACE RADIOS IN OPERATION.

HS - TBD

2.7 PERFORM RADIO TELEPHONE PROCEDURES.

HS - TBD

3. PLACE TURRET IN OPERATION

3.1 PERFORM PRE-MISSION CHECKLIST.

- 3.1.1 Turn TURRET DRIVE LOCK to LOCK position.
- 3.1.2 Check electrical harness for frayed wires and disconnected connectors.
- 3.1.3 Check hydraulic components for leaks.
- 3.1.4 Check hydraulic fluid reservoir level.
- 3.1.5 Check pop-up indicator on hydraulic fluid filter assembly. If up notify organizational maintenance.
- 3.1.6 Check Commander's and Gunner's sights and vision blocks .
- 3.1.7 Check gunner's nightsight power switch off.
- 3.1.8 Check gunner's nightsight RETICLE brightness control off.
- 3.1.9 Check Commander's nightsight power switch off.
- 3.1.10 Check Commander's nightsight RETICLE brightness control off.
- 3.1.11 Boresight knobs and diopter ring checked for movement.
- 3.1.12 Main gun and feed system checked.
  - 3.1.12.1 Main Gun manual safe ON (crosswise).
  - 3.1.12.2 Main Gun in SEAR.
  - 3.1.12.3 Feed Chutes in place.
  - 3.1.12.4 Link Chutes in place and clear.
- 3.1.13 Close and latch A.P. ammo cover.
- 3.1.14 Close and latch H.E. ammo cover.
- 3.1.15 Coax gun and feed system checked.
  - 3.1.15.1 Coax on safe.
  - 3.1.15.2 Feed chute in place.
  - 3.1.15.3 Link chute in place and clear.
- 3.1.16 Radio and intercom off.
- 3.1.17 Adjust seat.

3.2 PERFORM TURRET POWER-UP PROCEDURE.

- 3.2.1 Perform PRE-MISSION CHECKLIST.
- 3.2.2 Turn vehicle MASTER switch on.
- 3.2.3 Turn AUXILIARY POWER circuit breaker ON.
- 3.2.4 Verify that AUXILIARY PWR indicator is lit.

- 3.2.5 Turn TURRET POWER circuit breaker ON.
- 3.2.6 Verify that TURRET PWR indicator is lit.

NOTE

Electrical power is now available to entire turret.

- 3.2.7 Push lamp test switch to ON. Verify all lights functioning. Replace bulbs as necessary.
- 3.2.8 Turn TURRET DRIVE LOCK to UNLOCK.
- 3.2.9 Position DRIVE SELECT lever up for power mode.

WARNING

Verify that the vehicle is clear for turret operation, otherwise injuries to personnel or damage to equipment may occur.

- 3.2.10 Close palm switch.
- 3.2.11 Use both hand controls to drive gun and turret.

CAUTION

Turret operators are responsible for gun and bustle overhang during mobile operation.

- 3.3 PERFORM TURRET OPERATION PROCEDURES.
  - 3.3.1 Perform PRE-MISSION CHECKLIST.
  - 3.3.2 Perform TURRET POWER-UP PROCEDURE.
  - 3.3.3 Turn radio switch ON.
  - 3.3.4 Turn intercom switch ON.
  - 3.3.5 Perform ICS and radio checks.
  - 3.3.6 Turn vent switch on to check vent operation.
  - 3.3.7 Position DRIVE SELECT lever down for manual mode.
  - 3.3.8 Rotate elevation handcrank to move guns up and down.

- 3.3.9 Rotate azimuth handwheel to rotate turret clockwise and counterclockwise.
- 3.3.10 Position DRIVE SELECT lever up for POWER mode.
- 3.3.11 Perform CDU Lamp Test.
- 3.3.12 Close Gunner's palm switch.
- 3.3.13 Verify hydraulic pump operating.
- 3.3.14 Elevate Main gun from Gunner's hand control.
- 3.3.15 Traverse Turret from Gunner's hand control.
- 3.3.16 Elevate Main gun from Commander's hand control.
- 3.3.17 Traverse Turret from Commander's hand control.
- 3.3.18 Turn WEAPON POWER circuit breaker ON.
- 3.3.19 Verify WEAPON PWR indicator lit.
- 3.3.20 Set WPN ARM switch to ARM.
- 3.3.21 Perform DRY FIRE CHECKLIST.
- 3.3.22 Perform STAB OPERATING PROCEDURE.

#### 3.4 PERFORM M242 MAIN GUN CYCLING PROCEDURE

- 3.4.1 Perform M242 uploading procedures (2.1 and 2.2).
- 3.4.2 Place M242 safety to SAFE (crosswise).
- 3.4.3 Sound alert "POWER"; set TURRET POWER, WEAPON POWER and AUX POWER circuit breakers to ON position.
- 3.4.4 Verify that TURRET POWER, WEAPON POWER and AUX POWER indicators are lit.
- 3.4.5 Set WEAPON ARM switch to ARM.
- 3.4.6 Position DRIVE SELECT lever up for power mode.
- 3.4.7 Position gunner's MAIN/COAX switch to MAIN.
- 3.4.8 Verify "MAIN" indicator is lit.
- 3.4.9 Verify MAIN GUN "SEAR" indicator is lit.
- 3.4.10 Position gunner's AP/HE switch to AP.
- 3.4.11 Verify "AP" indicator is lit.
- 3.4.12 Position gunner's 200/100/SS switch to SS.
- 3.4.13 Verify "SS" indicator is lit.
- 3.4.14 Squeeze gunner's palm switch.
- 3.4.15 Lift trigger guard, squeeze gunner's trigger.
- 3.4.16 Verify bolt position indicator at MISFIRE.
- 3.4.17 Verify MISFIRE RESET warning indicator is lit.
- 3.4.18 Press MISFIRE RESET WARNING indicator.

- 3.4.19 Lift trigger guard, squeeze gunner's trigger.
- 3.4.20 Verify bolt position indicator at SEAR.

NOTE

Main Gun is now ready to fire. Place safety on FIRE when ready to continue engagement.

3.5 PERFORM M242 MAIN GUN BORESIGHTING PROCEDURE

- 3.5.1 Locate a target at 1000 meters.
- 3.5.2 Place vehicle on level surface.
- 3.5.3 Install 25mm adapter, boresight device and streamer.
- 3.5.4 Driver looks through boresight device and gives directions to the gunner to lay boresight cross to aiming point of target.
- 3.5.5 Gunner moves gun manually as directed by driver.
- 3.5.6 Driver rotates boresight device 180° degrees to check boresight alignment.

NOTE

Personnel in or on LAV should remain stationary during boresight alignment.

- 3.5.7 Verify gunner's sight is properly installed and secure.
- 3.5.8 Adjust gunner's M36E1 daylight boresight knobs to align boresight cross on target.
- 3.5.9 Rotate boresight knob collars so that number (4) four is on the index mark.
- 3.5.10 Repeat steps 3.5.7 through 3.5.9 for commander's daysight.
- 3.5.11 Remove the 25mm adaptor, boresight device and streamer and stow in proper compartment.

3.6 PERFORM M242 MAIN GUN ZEROING PROCEDURE

- 3.6.1 Perform boresight alignment procedures.
- 3.6.2 Identify a target at a known range (1000 meters).
- 3.6.3 Perform AP and HE uploading procedures.

- 3.6.4 Select aiming point on target.
- 3.6.5 Cycle the M242 to load the gun. (MISFIRE RESET light goes off).
- 3.6.6 Select proper range line on reticle to correspond to the known range to the target.
- 3.6.7 Use manual elevation handcrank and traversing handwheel to lay the proper range line on the target aiming point.
- 3.6.8 Fire one round at the target.
- 3.6.9 Manually relay on target and fire one round.
- 3.6.10 Repeat Step 3.6.9 until 3 to 5 rounds have been fired.
- 3.6.11 Relay on same aiming point. (Do not fire.)
- 3.6.12 Adjust reticle boresight knobs to move reticle range line to center-of-impact.
- 3.6.13 Relay on target and fire one check round.
- 3.6.14 Verify that check round is within tolerance TBD inches.

NOTE

If check round is not within tolerance repeat steps 3.6.9 - 3.6.13. If it still does not come within tolerance, notify organizational maintenance.

- 3.6.15 Using manual elevation handcrank and traversing handwheel, relay gunner's boresight cross on an identifiable aiming point.
- 3.6.16 Using boresight knobs, adjust commander's M-36E1 boresight cross to the same identifiable aiming point as gunner's boresight cross is on.
- 3.6.17 Record boresight knob setting, ammo, and range, in vehicle logbook.

3.7 PERFORM M-240 COAX BORESIGHT PROCEDURE.



NOTE

During the procedure, DO NOT move the boresight knobs.

- 3.7.1 Perform M242 boresight alignment procedure.
- 3.7.2 Perform M242 zeroing procedure.
- 3.7.3 Place vehicle on level surface.
- 3.7.4 Locate a target at Known Range (recommended 800 meters).
- 3.7.5 Perform Main gun Clearing procedure.
- 3.7.6 Install 7.62mm adapter, boresight device and streamer into muzzle of coax.
- 3.7.7 Move gun manually to lay the gunner's M36E1 boresight cross on an identifiable target aiming point.
- 3.7.8 Driver looks through boresight device and uses 14mm ratchet wrench on COAX mount boresight drive nuts to adjust deflection and elevation to the selected aiming point of the M36E1 boresight cross.

CAUTION

Deflection must be adjusted before elevation due to the configuration of the gun mount.

- 3.7.9 Remove 7.62 adapter, boresight, device and streamer and stow in proper compartment.

NOTE

COAX is now boresighted.

#### 4. OPERATE THE TURRET

##### 4.1 PERFORM M242 MAIN GUN PRE-FIRE CHECKLIST PROCEDURES (POWERED DRIVE).

- 4.1.1 Verify appropriate vehicle hatches closed and locked.
- 4.1.2 Turn AUXILIARY POWER circuit breaker ON.
- 4.1.3 Verify AUX PWR indicator lit.
- 4.1.4 Place safety to FIRE (inline).
- 4.1.5 Position DRIVE SELECT lever up for power mode.
- 4.1.6 Turn TURRET POWER circuit breaker ON.
- 4.1.7 Verify TURRET PWR indicator lit.
- 4.1.8 Position appropriate MAIN/COAX switch MAIN.
- 4.1.9 Verify MAIN GUN indicator lit.
- 4.1.10 Turn WEAPON POWER circuit breaker ON.
- 4.1.11 Verify WEAPON PWR indicator lit.
- 4.1.12 Set WEAPON ARM switch to ARM.
- 4.1.13 Verify appropriate LOW AMMO indicator not lit.
- 4.1.14 Verify MAIN GUN "SEAR" indicator lit.
- 4.1.15 Position AP/HE switch as appropriate.
- 4.1.16 Verify appropriate AP/HE indicator lit.
- 4.1.17 Position 200/100/SS switch as appropriate.
- 4.1.18 Verify appropriate 200/100/SS indicator lit.

#### NOTE

Weapon ready to fire from hand control.

##### 4.2 PERFORM M242 MAIN GUN PRE-FIRE CHECKLIST PROCEDURES (MANUAL DRIVE).

- 4.2.1 Verify appropriate vehicle hatches closed and locked.
- 4.2.2 Position AUXILIARY POWER circuit breaker to ON.
- 4.2.3 Verify AUX PWR indicator lit.
- 4.2.4 Place safety to FIRE (inline).
- 4.2.5 Position DRIVE SELECT lever down for manual mode.
- 4.2.6 Position appropriate MAIN/COAX switch MAIN.
- 4.2.7 Turn WEAPON POWER circuit breaker ON.
- 4.2.8 Verify WEAPON PWR indicator lit.
- 4.2.9 Position WPN ARM switch to ARM.
- 4.2.10 Verify appropriate LOW AMMO indicator not lit.

- 4.2.11 Verify MAIN gun indicator lit.
- 4.2.12 Verify SEAR indicator lit.
- 4.2.13 Position AP/HE switch as appropriate.
- 4.2.14 Verify appropriate AP/HE indicator lit.
- 4.2.15 Position 200/100/SS switch as appropriate.
- 4.2.16 Verify appropriate 200/100/SS indicator lit.

NOTE

Weapon ready to fire from auxiliary trigger.

- 4.3 PERFORM M240 COAX PRE-FIRE CHECKLIST PROCEDURES (POWERED DRIVE).
  - 4.3.1 Verify appropriate vehicle hatches closed and locked.
  - 4.3.2 Turn AUXILIARY POWER circuit breaker ON.
  - 4.3.3 Verify AUX PWR indicator lit.
  - 4.3.4 Position safety switch to F (Fire).
  - 4.3.5 Pull charging handle to rear.
  - 4.3.6 Position DRIVE SELECT lever up for power mode.
  - 4.3.7 Turn TURRET POWER circuit breaker ON.
  - 4.3.8 Verify TURRET PWR indicator lit.
  - 4.3.9 Position MAIN/COAX switch to COAX.
  - 4.3.10 Turn WEAPON POWER circuit breaker ON.
  - 4.3.11 Verify WEAPON PWR indicator lit.
  - 4.3.12 Set WEAPON ARM switch to ARM.
  - 4.3.13 Verify COAX LOW AMMO indicator not lit.
  - 4.3.14 Verify COAX indicator lit.

NOTE

Weapon ready to fire from hand control.

- 4.4 PERFORM M240 COAX PRE-FIRE CHECKLIST PROCEDURES (MANUAL DRIVE).
  - 4.4.1 Verify appropriate vehicle hatches closed and locked.
  - 4.4.2 Turn AUXILIARY POWER circuit breaker ON.
  - 4.4.3 Verify AUX PWR indicator lit.
  - 4.4.4 Position safety switch to F (Fire).
  - 4.4.5 Pull charging handle to rear.

- 4.4.6 Position DRIVE SELECT lever down for manual mode.
- 4.4.7 Position MAIN/COAX switch to COAX.
- 4.4.8 Verify COAX indicator lit.
- 4.4.9 Turn WEAPON POWER circuit breaker ON.
- 4.4.10 Verify WEAPON PWR indicator lit.
- 4.4.11 Set WEAPON ARM switch to ARM.
- 4.4.12 Verify COAX LOW AMMO indicator not lit.

NOTE

Weapon ready to fire from auxiliary trigger.

4.5 PERFORM STAB OPERATING PROCEDURE.

NOTE

STAB operation is effective only when vehicle is mobile.

- 4.5.1 Perform TURRET POWER-UP procedure.
- 4.5.2 Turn STAB switch ON.
- 4.5.3 Verify STAB ON indicator lit.
- 4.5.4 Verify STAB AZ and EL indicators not lit.
- 4.5.5 Perform M36E1 DAYSIGHT and/or NIGHTSIGHT operating procedures.
- 4.5.6 Close palm switch (keep hand control in neutral).
- 4.5.7 Check for drifting LOS.

NOTE

If LOS drifts more than 5 mils in 15 sec in azimuth or elevation perform LOS DRIFT COMPENSATION procedure.

4.6 PERFORM M36E1 DAYSIGHT OPERATING PROCEDURE.

- 4.6.1 Adjust seat height for use of daysight.

### WARNING

Do not aim sight at sun. Serious eye damage may occur.

### CAUTION

The nightsight will be damaged if exposed to daylight with the nightsight power switch ON. Before using the M36E1 sight during daylight, make sure nightsight power switch is in OFF position.

- 4.6.2 Open M119 sight shield by turning sight shield handle clockwise (15°) and pushing up.
- 4.6.3 Adjust brow pad for proper eye relief.
- 4.6.4 Sight a distant object through daysight and adjust diopter ring for sharp focus.
- 4.6.5 Record diopter setting.
- 4.6.6 Turn AUXILIARY POWER circuit breaker ON.
- 4.6.7 Verify that AUX PWR indicator lit.
- 4.6.8 Adjust reticle brightness for personal comfort.

### 4.7 PERFORM LOS DRIFT COMPENSATION PROCEDURE.

### NOTE

The LOS drift compensation procedure can be used anytime the turret is powered-up to keep the LOS from drifting. If STAB operation is not desired, omit steps 4.7.2 and 4.7.3.

- 4.7.1 Perform TURRET POWER-UP procedure.
- 4.7.2 Turn STAB switch ON.
- 4.7.3 Verify STAB ON indicator lit.
- 4.7.4 Verify that STAB AZ and EL indicators not lit..
- 4.7.5 Close palm switch (keep hand control in neutral).

4.7.6 If LOS drifts more than 5 mils in 15 sec., adjust STAB AZ and/or EL DRIFT knobs as required until LOS azimuth drift is less than 5 mils in 15 sec.

4.8 PERFORM M36E1 NIGHTSIGHT OPERATING PROCEDURE.

- 4.8.1 Loosen front and rear latches securing nightsight elbow to M36E1 sight assembly and remove elbow from sight assembly.
- 4.8.2 Remove and store rubber cover from nightsight elbow.
- 4.8.3 Position nightsight elbow on M36E1 sight assembly and secure with front and rear latches.
- 4.8.4 Turn AUXILIARY POWER circuit breaker ON.
- 4.8.5 Verify AUX PWR indicator lit.

CAUTION

Do not turn nightsight power switch ON during daylight. Exposure to bright light can damage image intensifier tube.

- 4.8.6 Turn nightsight elbow power switch (on right side of elbow) ON.
- 4.8.7 Adjust seat height for use of nightsight.
- 4.8.8 Adjust brow pad for personal comfort.
- 4.8.9 Sight through nightsight eyepiece and adjust diopter ring for sharp focus on nightsight screen.
- 4.8.10 Record diopter setting.
- 4.8.11 Open M119 sight shield by turning sight shield handle clockwise (15°) and pushing up.
- 4.8.12 Adjust focus ring as necessary for sharp focus on a distant object.
- 4.8.13 Adjust RETICLE BRIGHTNESS for personal comfort.

NOTE

Always turn off RETICLE BRIGHTNESS when not in use.

CAUTION

At end of mission and before full daylight,  
perform the following steps.

- 4.8.14 Turn nightsight power switch OFF.
- 4.8.15 Loosen front and rear latches securing nightsight elbow to M36E1 sight assembly and remove elbow from sight assembly.
- 4.8.16 Install rubber cover on nightsight elbow.
- 4.8.17 Position nightsight elbow on sight assembly and secure with front and rear latches.

5. PERFORM TARGET ACQUISITION

5.1 SELECT/OCCUPY OBSERVATION POSITIONS.

- 5.1.1 When moving use turret-down or hull-down routes.
- 5.1.2 When stationary use:
  - 5.1.2.1 Cover/concealed turret down positions with dismounted observer.
  - 5.1.2.2 Cover/concealed hull-down positions.

5.2 ASSIGN TARGET AREA RESPONSIBILITIES.

- 5.2.1 VC: look for likely targets within assigned sector of responsibility.
- 5.2.2 Gunner: look for likely targets within assigned sector of responsibility.

5.3 SCAN FOR TARGETS.

- 5.3.1 Without optics make quick overall search for obvious targets.
- 5.3.2 With optics make detailed search of terrain using 50 meter method.
  - 5.3.2.1 Search a strip 50 meters deep from right to left.
  - 5.3.2.2 Then search from left to right farther out overlapping the first strip.
  - 5.3.2.3 Continue until entire section is covered.
  - 5.3.2.4 When a suspicious spot is detected, stop and search it thoroughly.
- 5.3.3 Search from far to near when suspecting air threat.

5.4 PERFORM NIGHT ACQUISITION.

- 5.4.1 Scan with off-center vision with short, abrupt, irregular eye movements. Pause a few seconds to detect any motion at each likely target.
- 5.4.2 Listen for sounds and smell for odors.
- 5.4.3 Use night vision devices (passive).



5.5 SCAN FOR TARGET IDENTIFICATION.

5.5.1 Identify target as friend or foe.

5.5.2 Rank threat as:

5.5.2.1 Most dangerous.

5.5.2.2 Dangerous.

5.5.2.3 Least dangerous.

5.5.3 Acquisition reports:

5.5.3.1 Who is reporting?

5.5.3.2 Target description.

5.5.3.3 Where the target is.

5.5.3.4 What the target is doing.

NOTE

If time permits, proceed with 5.5.4.

5.5.4 SALUTE

5.5.4.1 Size.

5.5.4.2 Activity.

5.5.4.3 Location.

5.5.4.4 Unit.

5.5.4.5 Time.

5.5.4.6 Equipment.

6. EMPLOY WEAPON SYSTEM

6.1 ISSUE INITIAL FIRE COMMAND.

- 6.1.1 Commander announces the Alert.
- 6.1.2 Commander announces the type of Ammunition and rate of fire.
- 6.1.3 Commander announces target description.
- 6.1.4 Commander announces the direction in which to slew the turret. (This step may be omitted.)
- 6.1.5 Commander announces the approximate range of the target. (This step may be omitted.)
  - 6.1.5.1 Commander slews turret in direction indicated.
  - 6.1.5.2 Gunner announces "IDENTIFIED" when he sees the TARGET. (This step will occur the instant the gunner sees the target.)

NOTE

Once Gunner announces "IDENTIFIED," Commander releases the override of the gun, and turns control of the gun to the gunner. Once Gunner has control of the gun he makes a precision lay of the gun.

- 6.1.6 Commander announces "FIRE."
- 6.1.7 Commander announces "ON THE WAY."
- 6.1.8 Gunner announces "CEASE FIRE."

6.2 PERFORM PRECISION FIRING SEQUENCE.

- 6.2.1 Acquire target within the sight's field of view.
- 6.2.2 Determine range utilizing stadia reticle or the most accurate means available.
- 6.2.3 Determine the type of ammunition. Range numbers on the left side of reticle are used for HE and TP ammunition. AP range is identified on the right side of reticle.

- 6.2.4 Determine the sighting point on the reticle. Select the point on the range line that corresponds to the range determined in step 2 and the type of ammunition selected in step 3.
- 6.2.5 Determine cross range velocity. Cross range velocity is defined as movement of the target or vehicle perpendicular to the line of fire. If cross range velocity is zero, the gun is now aimed. If it is not zero, then a lead angle must be developed.
- 6.2.6 Determine lead angle direction. Using your vehicle as reference, determine whether the target vehicle is moving to your right or left. Move the sighting point in the direction of target movement.
- 6.2.7 Determine lead angle. Using the estimated cross range velocity, apply lead angle as appropriate from the lead angle table.

LEAD ANGLE TABLE		
CROSS RANGE VELOCITY	LEAD ANGLE IN MILLS	
Miles Per Hours	AP	HE
5 MPH	2	3
15 MPH	05	08
30 MPH	11	16
50 MPH	18	27

- 6.2.8 Determine the sighting point on the reticle. Move the sighting point (step 4) in the lead angle direction (step 6) by the amount of mils in the lead angle (step 7).
- 6.2.9 FIRE on command.

### 6.3 APPLY BATTLESIGHT FIRING TECHNIQUE.

- 6.3.1 Prepare for battlesight firing technique
  - 6.3.1.1 Determine the most likely targets to be engaged.
  - 6.3.1.2 Determine the type of ammunition to be fired.
  - 6.3.1.3 Select the designated ammunition.

- 6.3.1.4 Cycle the M242 Main Gun in order to load the gun.
- 6.3.1.5 Set M242 Main gun safety to FIRE (inline).
- 6.3.1.6 Set WPN ARM switch to SAFE.
- 6.3.2 Acquire the target
- 6.3.3 Using choke reticle, determine appropriate range for ammunition selected.
- 6.3.4 Determine that target is in Battlesight range.
- 6.3.5 Issue fire command.
  - 6.3.5.1 Commander announces "GUNNER," and slews turret in direction of target.
  - 6.3.5.2 Commander announces "BATTLESIGHT."
  - 6.3.5.3 Gunner sets WPN ARM switch to ARM
  - 6.3.5.4 Commander announces the description of target (e.g., BMP, Troop, Tank).
  - 6.3.5.5 Gunner announces "IDENTIFIED."
  - 6.3.5.6 Commander releases hand control.
  - 6.3.5.7 Commander announces "FIRE."
  - 6.3.5.8 Gunner makes final lay of gun, announces "ON THE WAY," and FIRES.
  - 6.3.5.9 Commander announces "CEASE FIRE."
- 6.4 PERFORM SENSING AND BURST ON TARGET ADJUSTMENT.
  - 6.4.1 Gunner calls out range sensings: short, over, target, doubtful or lost (gunner).
  - 6.4.2 Employ burst on target for direct fire adjustment:
    - 6.4.2.1 Fire 3 to 5 round burst.
    - 6.4.2.2 Adjust center of impact to center of mass of target.
    - 6.4.2.3 For moving targets using BOT, track continuously before, during and after firing (gunner)

NOTE

If burst on target not possible, Commander issues subsequent fire command.

6.4.3 Issue subsequent fire command, if necessary (Vehicle Commander)

- 6.4.3.1 Alert (SHORT, OVER, ON TARGET, LOST, DOUBTFUL)
- 6.4.3.2 Deflection correction (When given, it is LEFT or RIGHT by specified number of mils).
- 6.4.3.3 Range correction (Add or drop by number of meters)
- 6.4.3.4 Execution (FIRE)
- 6.4.3.5 Corrections (Repeat 6.4.3.1 through 6.4.3.4)
- 6.4.3.6 Target (Describe target)
- 6.4.3.7 Cease fire

6.5 ENGAGE TARGETS WITH M242 MAIN GUN CANNON.

- 6.5.1 Estimate range to target.
- 6.5.2 Estimate speed of moving target.
- 6.5.3 Move controls to correct aim point.
- 6.5.4 Fire M242 at stationary target from stationary vehicles.
- 6.5.5 Fire M242 at stationary target from moving vehicle.
- 6.5.6 Fire M242 at moving target from stationary vehicle.
- 6.5.7 Fire M242 at moving target from moving vehicle.
- 6.5.8 Adjust rounds to target using burst-on-target (BOT) method.

6.6 ENGAGE TARGETS WITH M240 COAX MACHINE GUN.

- 6.6.1 Estimate range to target.
- 6.6.2 Estimate speed of moving target.
- 6.6.3 Move controls to correct aim point.
- 6.6.4 Fire M240 at stationary target from stationary vehicle.
- 6.6.5 Fire M240 at stationary target from moving vehicle.
- 6.6.6 Fire M240 at moving target from stationary vehicle.
- 6.6.7 Fire M240 at moving target from moving vehicle.

6.7 EMPLOY M257 GRENADE LAUNCHER.

## WARNING

Crew should be in vehicle and all hatches closed when firing grenade launcher.

- 6.7.1 Turn WEAPON POWER circuit breaker ON.
  - 6.7.2 Verify WEAPON PWR indicator lit.
  - 6.7.3 Turn either or both salvo switches on.
  - 6.7.4 Verify GRENADE LAUNCHER READY INDICATOR lit.
  - 6.7.5 Lift fire switch guard and push up on fire toggle switch.
  - 6.7.6 Turn either or both salvo switches off.
  - 6.7.7 Verify that ready indicator not lit.
- 6.8 SELECT AND OCCUPY FIRING POSITIONS.
- 6.8.1 Primary Position - Position LAV to cover most likely enemy avenues of approach.
  - 6.8.2 Alternate Position - Position LAV to cover same target areas as primary position.
  - 6.8.3 Supplementary Position - Position LAV to cover target areas or enemy routes of advance that cannot be covered from primary or alternate positions (usually flanks or rear).
  - 6.8.4 Use turret-down positions when observing and acquiring targets.
  - 6.8.5 Use hull-down positions for all direct fire gun engagements.
  - 6.8.6 Turret-down to hull-down:
    - 6.8.6.1 Move LAV forward slowly (driver).
    - 6.8.6.2 Level the gun and look through optical sight (gunner).
    - 6.8.6.3 Stop LAV where target can be seen without obstruction.
  - 6.8.7 Defensive operations:
    - 6.8.7.1 Select covered and concealed positions below the topographical crest and preferably on the sides of a hill to avoid skylining.

- 6.8.7.2     Avoid swampy areas and hillsides, select positions which are dry and level.
- 6.8.7.3     Select covered and concealed routes into and out of the position.
- 6.8.7.4     Avoid selecting positions near or within prominent terrain features.
- 6.8.7.5     Avoid unnecessary movement and heat and light generation while in positions.
- 6.8.7.6     Camouflage is continuous.

## 7. PERFORM IMMEDIATE ACTION PROCEDURES

### 7.1 STOP RUNAWAY TURRET.

- 7.1.1 Turn TURRET POWER circuit breaker OFF. If Turret does not stop go to Step 7.1.2.
- 7.1.2 Position DRIVE SELECT lever down for manual mode. If Turret does not stop go to Step 7.1.3.
- 7.1.3 Turn VEHICLE MASTER SWITCH to OFF.
- 7.1.4 Turn TURRET DRIVE LOCK to LOCK.

### 7.2 REDUCE M242 MAIN GUN FAILURE TO FIRE.

- 7.2.1 Verify that M242 safety is in FIRE position (inline).
- 7.2.2 Verify bolt position indicator in SEAR.
- 7.2.3 Verify level of ammunition.
- 7.2.4 If ammunition is exhausted perform ammo uploading procedure.
- 7.2.5 If ammunition is present check
  - 7.2.5.1 Check to see if ammo is binding in box.
  - 7.2.5.2 Check that feed chutes are latched in place at main gun feeder and at ammo box.
  - 7.2.5.3 Check that feed chutes have no binding ammo, broken ammo belt, or separated ammo belt.
  - 7.2.5.4 Check that ammo links are not binding in link ejection chutes. If links are binding, notify organizational maintenance.
- 7.2.6 Attempt to fire weapon. If weapon fires continue mission. If weapon fails to fire, go to 7.2.7.
- 7.2.7 Ensure lead round is in feed sprocket.
  - 7.2.7.1 With 14 mm ratchet wrench, turn ammo forwarder 1/4 turn to forward ammo.

#### NOTE

To forward AP ammo, turn AP forwarder clockwise.  
To forward HE ammo, turn HE forwarder counter-clockwise.



- 7.2.8 If bolt position indicator is not in SEAR and it is before DWELL, place a No. 4 cross point screwdriver on the drive shaft and turn handle clockwise to move bolt position indicator back to SEAR.
- 7.2.9 If bolt position indicator is not in SEAR and is after DWELL, place a No. 4 crosspoint screwdriver on drive shaft and turn drive shaft counterclockwise to move bolt position indicator forward to SEAR.
- 7.2.10 Fire main gun. If main gun fires, end troubleshooting. If main gun fails to fire, notify organizational maintenance.

7.3 PERFORM M242 MAIN GUN MISFIRE PROCEDURE (COOL GUN).

NOTE

Main gun is considered cool if less than 50 rounds have been fired in last five minutes.

WARNING

Accidental firing of main gun could result in death or injury. Ensure that main gun is aimed in a safe direction and that no personnel or equipment are in line of fire.

- 7.3.1 If first round, ensure M242 safety is in FIRE (inline).
- 7.3.2 Wait five seconds. Press misfire reset warning indicator.
- 7.3.3 Close palm switch and squeeze trigger on gunner's hand control. Gun should fire. If not go to 7.3.4.
- 7.3.4 Set WEAPON ARM switch to SAFE.
- 7.3.5 Place M242 safety to SAFE (crosswise).
- 7.3.6 Set WEAPON ARM switch to ARM.
- 7.3.7 Press MISFIRE RESET WARNING INDICATOR.
- 7.3.8 Position Gunner's 200/100/SS switch to SS.
- 7.3.9 Place M242 safety to FIRE (inline).

- 7.3.10 Close palm switch and squeeze trigger on Gunner's Hand Control.

NOTE

Bolt position indicator on main gun should cycle to SEAR and SEAR indicator on CDU should light. If conditions are obtained, proceed to step 7.3.13. If conditions are not obtained, perform steps 7.3.11 or 7.3.12 as required.

- 7.3.11 If bolt position indicator has not cycled out of the MISFIRE position, proceed to IMMEDIATE ACTION TO CLEAR JAMMED MAIN GUN procedure.
- 7.3.12 If bolt position is at SEAR but SEAR indicator on CDU is not lit, press LAMP TEST switch up to ON.. If SEAR indicator lights, go to 7.3.13.

NOTE

If SEAR indicator does not light, replace bulb at first opportunity.

- 7.3.13 Close palm switch and squeeze trigger on Gunner's Hand Control.
- 7.3.13.1 If main gun fires, gun is operational. Go to 7.3.14.
- 7.3.13.2 If bolt position indicator cycles to MISFIRE, troubleshoot malfunction.
- 7.3.14 Reset Gunner's 200/100/SS switch to desired setting and continue mission.

- 7.4 PERFORM M242 MAIN GUN MISFIRE PROCEDURE (HOT GUN).  
Main gun is considered hot if more than 100 rounds have been fired in last fifteen minutes.

#### WARNING

Accidental firing of main gun could result in death or injury. Ensure that main gun is aimed in a safe direction and that no personnel or equipment are in line of fire.

- 7.4.1 Set WEAPON ARM switch to SAFE.
- 7.4.2 Place M242 safety to SAFE (crosswise).
- 7.4.3 Set WEAPON ARM switch to ARM.
- 7.4.4 Position Gunner's 200/100/SS switch to SS.
- 7.4.5 Set main gun manual safety to FIRE (inline).
- 7.4.6 Close palm switch and squeeze trigger on Gunner's Hand Control.

#### NOTE

Bolt position indicator on main gun should cycle to SEAR and SEAR indicator on CDU should light. If conditions are obtained, proceed to step 7.4.9. If conditions are not obtained, perform steps 7.4.7 or 7.4.8 as required.

- 7.4.7 If bolt position indicator has not cycled out of MISFIRE, WARN ALL PERSONNEL OF A COOKOFF DANGER. All personnel shall remain clear of gun barrel for thirty minutes or until round cooks off, whichever occurs first. Proceed then to step 7.4.10.
- 7.4.8 If bolt position indicator cycles to MISFIRE, troubleshoot.
- 7.4.9 Close palm switch and squeeze trigger on Gunner's Hand Control.
  - 7.4.9.1 If main gun fires, gun is operational. Go to 7.4.11.
  - 7.4.9.2 If bolt position indicator cycles to MISFIRE, troubleshoot.
- 7.4.10 Cycle main gun to SEAR position as follows:
  - 7.4.10.1 Open weapons enclosure bag.

- 7.4.10.2 Turn locking ring on power cable left and unplug cable.
- 7.4.10.3 Place M242 safety to SAFE (crosswise).
- 7.4.10.4 Insert handcrank into manual drive gear hub.

NOTE

Main gun cannot be cycled to SEAR position if it is jammed. If gun cannot be cycled to SEAR position, proceed to IMMEDIATE ACTION TO CLEAR JAMMED MAIN GUN procedure.

- 7.4.10.5 Press in and hold sear release link lever.
- 7.4.10.6 Turn handcrank counterclockwise. Let go of sear release link lever when bolt position indicator clears MISFIRE position.
- 7.4.10.7 When bolt position indicator reaches SEAR position, stop turning handcrank and remove it from manual drive gear hub.
- 7.4.10.8 Connect power cable to M242 and turn locking ring to the right to lock.
- 7.4.11 Place M242 safety to FIRE (in line).
- 7.4.12 Position Gunner's 200/100/SS switch to desired setting and continue mission.
- 7.4.13 Troubleshoot cause of misfire at earliest opportunity.

- 7.5 PERFORM SAFETY PROCEDURES WHEN HOT M242 MAIN GUN FAILS TO FIRE AND BOLT POSITION INDICATOR IN POSITION OTHER THAN SEAR AND MISFIRE.

WARNING

Main gun is considered hot if more than 100 rounds have been fired in the past 15 minutes or 50 rounds in the past 5 minutes.

- 7.5.1 Notify all persons aboard of cookoff danger.
- 7.5.2 Notify driver to stop vehicle and set master switch to OFF.

- 7.5.3 All personnel except Commander exit vehicle immediately
- 7.5.4 Commander aim gun downrange.
- 7.5.5 Turn TURRET POWER, WEAPON POWER and AUXILIARY POWER circuit breakers to OFF.
- 7.5.6 Set Turret Drive Lock to LOCK. Exit vehicle.
- 7.5.7 Remain clear of vehicle for 30 minutes or until cookoff.
- 7.5.8 After 30 minutes or cookoff troubleshoot main gun.

7.6 PERFORM IMMEDIATE ACTION TO CLEAR JAMMED MAIN M242 GUN.

WARNING

Accidental firing of M242 could result in death or injury. Ensure that M242 is aimed in a safe direction and that no personnel or equipment is in line of fire.

- 7.6.1 Tell driver to stop vehicle.
- 7.6.2 Turn TURRET POWER and WEAPON POWER circuit breakers OFF.
- 7.6.3 Turn TURRET DRIVE LOCK to LOCK.
- 7.6.4 Set WPN ARM switch to SAFE.
- 7.6.5 Place M242 safety to SAFE (crosswise).
- 7.6.6 Turn locking ring on power cable to left and disconnect power cable.
- 7.6.7 Use manual elevation handcrank to raise gun to between 15° and 30° elevation.
- 7.6.8 Disconnect link chutes from main gun feeder as follows:
  - 7.6.8.1 Release latch on link chute and move chute away from feeder.
  - 7.6.8.2 Disconnect links in link chute from link coming out of feeder.
  - 7.6.8.3 Move link chute out of way so feeder can be removed.
- 7.6.9 Disconnect feed chutes from feeder.
- 7.6.10 Break ammo belts at feeder.
- 7.6.11 Press button in center of drive shaft knob and pull drive shaft knob down approximately three inches.

- 7.6.12 Press and hold feeder handle lock.
- 7.6.13 Rotate feeder handle up (away from gun).
- 7.6.14 Release feeder handle lock.
- 7.6.15 Slide feeder from main gun. If feeder will not slide out, locate jam and remove it. If jam cannot be safely removed, notify organizational maintenance.
- 7.6.16 Place main gun feeder on floor.
- 7.6.17 Remove jammed AP and HE rounds and links from main gun feeder as follows:
  - 7.6.17.1 Press feed select solenoid knob in.
  - 7.6.17.2 Press in and hold timer lift rod in center of worm nut shaft.
  - 7.6.17.3 Turn worm nut shaft counter clockwise and release timer lift rod. Continue turning worm nut shaft counterclockwise until timer lift rod pops back out.
  - 7.6.17.4 Repeat substeps 7.6.17.2 through 7.6.17.3 until feeder is cleared of AP ammo.
  - 7.6.17.5 Pull feed select solenoid knob out.
  - 7.6.17.6 Repeat substeps 7.6.17.1 through 7.6.17.5 for HE ammo.
- 7.6.18 Inspect main gun feeder for damage. If feeder is not damaged, it may be reinstalled after receiver is cleared. If feeder is damaged, notify organizational maintenance.
- 7.6.19 Inspect receiver for jammed rounds. If there are no jammed rounds, proceed to step 7.6.23. If there are jammed rounds, proceed to step 7.6.20.
- 7.6.20 Remove jammed round from receiver assembly. If jammed round cannot be safely removed, notify organizational maintenance. If round is jammed in chamber and bolt is closed, proceed to step 7.6.21.
- 7.6.21 Unlock and retract bolt from chamber as follows:
  - 7.6.21.1 Place 12-inch adjustable wrench on square part of bolt shaft just behind bolt lugs.
  - 7.6.21.2 Press SEAR release solenoid.
  - 7.6.21.3 Turn bolt clockwise with wrench to unlock.

- 7.6.21.4 Turn drive shaft, on bottom of receiver, counterclockwise to retract bolt from chamber. If bolt will not retract, notify organizational maintenance.
  - 7.6.22 Remove jammed round from receiver. If jammed round cannot be safely removed from receiver, notify organizational maintenance.
  - 7.6.23 Inspect receiver for damage. If receiver is undamaged, reinstall feeder per main gun feeder installation procedure. If receiver is damaged, notify organizational maintenance.
  - 7.6.24 Reload main gun per HE and AP FEED SYSTEM LOADING procedures.
- 7.7 STOP RUNAWAY M240 COAX.

#### WARNING

Runaway COAX can cause death or injury.  
Keep COAX pointed in a safe direction.

- 7.7.1 Set WEAPON ARM switch to SAFE. If COAX continues to fire, go to 7.7.2.
- 7.7.2 Point COAX in safe direction.
- 7.7.3 Tell driver to stop vehicle.
- 7.7.4 Turn TURRET POWER circuit breaker OFF.
- 7.7.5 Verify TURRET PWR indicator light OFF
- 7.7.6 Turn WEAPON POWER circuit breaker OFF.
- 7.7.7 Verify WEAPON PWR indicator OFF.
- 7.7.8 If COAX still fires after power OFF:
  - 7.7.8.1 Grab COAX charger handle, pull back and hold or
  - 7.7.8.2 Grab COAX ammo belt at ammo box, twist and hold or
  - 7.7.8.3 If near end of ammo belt let COAX fire until end of ammo.
- 7.7.9 Perform immediate action to clear COAX.
- 7.7.10 Unload COAX and notify organizational maintenance.

7.8 REDUCE COAX GUN FAILURE TO FIRE (HOT GUN).

WARNING

When COAX is hot, COOKOFF of live round can kill or injure. If immediate action cannot be completed within 1 minute exit turret for 30 minutes. COAX is considered HOT when 300 rounds have been fired in 3 minutes or less.

- 7.8.1 Set WEAPON ARM switch to safe.
- 7.8.2 Position COAX manual safety to S (safe).
- 7.8.3 Pull back firmly on charger handle to eject misfired shell and charge COAX.  
If COAX is hot and bolt does not lock in rear position, go to Step 7.8.5.
- 7.8.4 If misfired round is ejected and COAX gun charges, set manual safety to F (FIRE), set WEAPON ARM switch to ARM, and continue firing.
- 7.8.5 Notify all personnel aboard vehicle of COOKOFF danger.
- 7.8.6 Commander aim gun downrange.
- 7.8.7 Notify driver to stop vehicle and set vehicle master switch to OFF.
- 7.8.8 All personnel except commander exit vehicle immediately.
- 7.8.9 Commander sets TURRET POWER, WEAPON POWER, AUXILIARY POWER circuit breakers to OFF.
- 7.8.10 Set TURRET DRIVE LOCK to LOCK and exit vehicle.
- 7.8.11 After 30 minutes return to vehicle and perform COAX clearing procedure.

7.9 PERFORM M240 COAX MISFIRE PROCEDURE.



## WARNING

COAX is considered hot if more than 100 rounds have been fired in two minutes. If COAX is hot, do not perform any of the following steps, but go to COAX FAILS TO FIRE (HOT GUN) Procedure.

- 7.9.1 Attempt to fire round by charging it and firing the COAX several times.
- 7.9.2 If COAX is still jammed, pull charger handle to rear to lock bolt back.
- 7.9.3 Place COAX manual safety to S (safe).
- 7.9.4 Push in latches and open cover assembly.
- 7.9.5 Remove ammo belt.
- 7.9.6 Raise feed tray.
- 7.9.7 Locate round in chamber.
- 7.9.8 Perform COAX removal procedure, remove jammed barrel and set aside.
- 7.9.9 Change barrel so COAX is ready to fire.
- 7.9.10 Perform COAX installation procedure.
- 7.9.11 Perform necessary COAX uploading procedure to reload COAX.
- 7.9.12 Place COAX manual safety to F (fire), and continue mission.
- 7.9.13 To remove stuck cartridge case from jammed barrel, perform following substeps:
  - 7.9.13.1 Lift case from chamber. Pry case rim with screwdriver if case is tight.
  - 7.9.13.2 If case cannot be pried loose, remove swab holder from cleaning rod, insert rod through muzzle of barrel and gently tap rod to dislodge case from barrel.
- 7.9.14 To remove ruptured cartridge case from jammed barrel, perform following substeps:
  - 7.9.14.1 Push ruptured cartridge extractor through ruptured case.
  - 7.9.14.2 Pull back on extractor handle to remove ruptured case from barrel.

- 7.9.15 To remove live round that was fed into a ruptured case from jammed barrel, perform following substeps:
  - 7.9.15.1 Perform substeps 7.9.12.1 and 7.9.12.2 to remove live round from ruptured case.
  - 7.9.15.2 Push ruptured cartridge case extractor through ruptured case.
  - 7.9.15.3 Pull back on extractor handle to remove ruptured case from barrel.
- 7.10 REDUCE M257 GRENADE LAUNCHER FAILURE TO LAUNCH.
  - 7.10.1 Stay clear of the launcher barrel for at least 30 minutes. Keep the launcher pointed downrange.
  - 7.10.2 After 30 minutes, follow the download procedure, store misfired grenade at safe distance from vehicle and notify organizational maintenance.
- 7.11 PERFORM EMERGENCY TURRET POWER-DOWN PROCEDURE.
  - 7.11.1 Turn TURRET POWER circuit breaker OFF.
  - 7.11.2 Turn WEAPON POWER circuit breaker OFF.
  - 7.11.3 Turn vehicle MASTER switch OFF.
- 7.12 PERFORM LOW AMMO OVERRIDE PROCEDURE.

NOTE

If firing of the Main Gun or COAX is required and a LOW AMMO indicator is lit, perform 7.12.1.

- 7.12.1 To fire the selected low ammo, cycle the LOW AMMO OVERRIDE switch in the spring loaded ON position.

8. PERFORM POST-OPERATING PROCEDURES

8.1 PERFORM M242 MAIN GUN DOWNLOADING PROCEDURE.

- 8.1.1 Turn TURRET POWER circuit breaker OFF.
- 8.1.2 Verify TURRET PWR indicator not lit.
- 8.1.3 Turn TURRET DRIVE LOCK to LOCK.
- 8.1.4 Turn WEAPON POWER circuit breaker OFF.
- 8.1.5 Verify WEAPON PWR indicator not lit.
- 8.1.6 Place M242 manual safety to SAFE (crosswise).
- 8.1.7 Verify WPN ARM switch on SAFE.
- 8.1.8 If unloading AP, pull out feed select solenoid. If unloading HE, push in feed select solenoid.
- 8.1.9 Pull and hold the ready box forwarder release lever.
- 8.1.10 Pull mushroom (feed chute stop) to release the ammo belt.
  - 8.1.10.1 If feeder is jammed, it may be necessary to break the ammo belt at the feeder by releasing the feed chute and pulling one round out of the belt.
  - 8.1.10.2 Ammo belt will normally slide down the feedchute. However, if it doesn't, it can be cranked down using the 14mm ratchet wrench on the feed sprocket extension turning it in opposite direction of arrow..
  - 8.1.10.3 Stow 14 mm ratchet wrench.
  - 8.1.10.4 Repeat Steps 8.1.8 through 8.1.10.
- 8.1.11 Release forwarder release lever.
- 8.1.12 There is one round in the feeder, which can be fired downrange or removed by removing the feeder and cycling it manually.

8.2 PERFORM M240 COAX DOWNLOADING PROCEDURE.

- 8.2.1 Turn TURRET POWER circuit breaker OFF.
- 8.2.2 Verify TURRET PWR indicator not lit.
- 8.2.3 Turn TURRET DRIVE LOCK to LOCK.

## WARNING

Downloading procedures requires working from inside of vehicle through turret opening. To prevent injury to personnel or damage to equipment, ensure that TURRET POWER circuit breaker remains in OFF position and TURRET DRIVE LOCK remains at LOCK position while working through turret opening.

- 8.2.4 Turn WEAPON POWER circuit breaker OFF.
  - 8.2.5 Verify WEAPON PWR indicator not lit.
  - 8.2.6 Turn WPN ARM switch to SAFE.
  - 8.2.7 Pull charging handle to rear to lock bolt back.
  - 8.2.8 Place COAX manual safety to S (safe).
  - 8.2.9 Push in latches and open cover assembly.
  - 8.2.10 Remove lead end of ammo belt from feed tray.
  - 8.2.11 Slide ammo belt back into feed chute.
  - 8.2.12 Raise feed tray.
  - 8.2.13 Look into chamber. If empty go to 8.2.14. If round in chamber perform COAX MISFIRE CLEARING procedure.
  - 8.2.14 Lower feed tray.
  - 8.2.15 Close cover.
  - 8.2.16 Place COAX manual safety to F (fire).
  - 8.2.17 Pull charging handle to rear, squeeze trigger, and ease bolt forward.
  - 8.2.18 Remove ammo belt from feed chute and 7.62 ammo box.
- 8.3 PERFORM M257 GRENADE LAUNCHER DOWNLOADING PROCEDURE.
- 8.3.1 Turn TURRET POWER circuit breaker OFF.
  - 8.3.2 Verify TURRET PWR indicator not lit.
  - 8.3.3 Turn TURRET DRIVE LOCK to LOCK position.
  - 8.3.4 Turn WEAPON POWER circuit breaker OFF.
  - 8.3.5 Verify WEAPON PWR indicator is not lit.
  - 8.3.6 Verify SALVO switches OFF.
  - 8.3.7 Use a grenade removing tool or a hooked wire to remove the grenades.

- 8.3.8 Store the grenades properly in grenade box.

WARNING

Do not place any part of hands or body  
in front of launcher.

8.4 PERFORM TURRET POWER-DOWN PROCEDURE.

- 8.4.1 Turn WPN ARM switch to SAFE.
- 8.4.2 Turn WEAPON POWER circuit breaker OFF.
- 8.4.3 Verify WPN PWR indicator not lit.
- 8.4.4 Verify VENT switch OFF.
- 8.4.5 Position turret (guns forward at approximately +10° elevation).
- 8.4.6 Turn TURRET POWER circuit breaker OFF.
- 8.4.7 Verify TURRET PWR indicator not lit.
- 8.4.8 Turn TURRET DRIVE LOCK to LOCK.
- 8.4.9 Close Gunner's M36E1 sight shield.
- 8.4.10 Close Commander's M36E1 sight shield.
- 8.4.11 Turn intercom off.
- 8.4.12 Turn all radios off.
- 8.4.13 Verify Gunner's and Commander's nightsight RETICLE  
Brightness Control OFF
- 8.4.14 Verify Gunner's and Commander's nightsight power switches  
OFF
- 8.4.15 Turn AUXILIARY POWER circuit breaker OFF.
- 8.4.16 Verify AUX PWR indicator not lit
- 8.4.17 Turn vehicle MASTER switch off.
- 8.4.18 If required, close and lock Gunner's hatch.
- 8.4.19 If required, close and lock Commander's hatch.

8.5 PERFORM POST MISSION CHECKLIST PROCEDURE.

- 8.5.1 Turn TURRET DRIVE LOCK level to LOCKED position.
- 8.5.2 Check electrical harness for frayed wires and disconnected connectors.
- 8.5.3 Check hydraulic components for leaks.

- 8.5.4 Check hydraulic fluid reservoir level.
- 8.5.5 Check pop-up indicator on hydraulic fluid filter assembly. If up, notify organizational maintenance.
- 8.5.6 Check Commander's and Gunner's sights and vision blocks.
- 8.5.7 Verify Gunner's nightsight power switch OFF.
- 8.5.8 Verify Gunner's nightsight RETICLE Brightness control OFF.
- 8.5.9 Verify Commander's nightsight power switch OFF.
- 8.5.10 Verify Commander's nightsight RETICLE Brightness control OFF.
- 8.5.11 Check boresight/zeroing knobs for movement.
- 8.5.12 Check M242 Main gun and feed system.
  - 8.5.12.1 Main Gun manual safety to safe (crosswise).
  - 8.5.12.2 Main Gun in SEAR.
  - 8.5.12.3 Feed Chutes in place.
  - 8.5.12.4 Link Chutes in place and clear.
- 8.5.13 Verify A.P. ammo cover closed and latched.
- 8.5.14 Verify H.E. ammo cover closed and latched.
- 8.5.15 Check M240 COAX and Feed System.
  - 8.5.15.1 COAX manual safe on S (safe).
  - 8.5.15.2 Feed chute in place
  - 8.5.15.3 Link chute in place and clear
- 8.5.16 Radio and intercom systems OFF.
- 8.5.17 Perform M242 MAIN GUN preventive maintenance procedure.
- 8.5.18 Perform M240 COAX preventive maintenance procedure.
- 8.5.19 Perform M257 grenade launcher preventive maintenance procedure.
- 8.5.20 Perform optics and fire control equipment preventive maintenance.

8.6 MAINTAIN WEAPONS RECORD DATA/GUN BOOK ON M240/M242/M257  
ITS - TBD

8.7 MAINTAIN VEHICLE LOGBOOKS  
ITS - TBD

8.8 INITIATE VEHICLE WORK ORDERS  
ITS - TBD

9. PERFORM PREVENTIVE MAINTENANCE

9.1 CLEAN, INSPECT, LUBRICATE M242 MAIN GUN.

- 9.1.1 Feeder Assembly - Clean, inspect and lubricate.
  - 9.1.1.1 Perform feeder removal procedure.
  - 9.1.1.2 Perform feeder disassembly procedure.
  - 9.1.1.3 Wipe feeder with a clean rag dampened in LSA/CLP. Turn rotor to clean internal parts.
  - 9.1.1.4 Wipe feeder with clean dry rag.
  - 9.1.1.5 Rotate feeder handle to see if it locks and unlocks.
  - 9.1.1.6 Push Feed Select Solenoid to AP position and turn Worm Nut Shaft until it locks into position.
  - 9.1.1.7 Pull Feed Select Solenoid out to HE position and turn Worm Nut Shaft until it locks in position.

NOTE

While turning Worm Nut Shaft, observe for movement of feed sprocket, rotor, and Bolt Position Indicator.

- 9.1.1.8 Lubricate Feeder Assembly.

NOTE

DO NOT LUBRICATE Feed Select Solenoid, electrical connectors, cables or Bolt Position Indicator.

- 9.1.2 Receiver - Clean, inspect, lubricate.
  - 9.1.2.1 Perform Track and Bolt Removal Procedure.
  - 9.1.2.2 Clean heavy dirt from the receiver with soft brush.
  - 9.1.2.3 Clear receiver with a clean rag dampened in LSA/CLP.

NOTE

Keep LSA/CLP away from electrical connectors, Sear Solenoid cable and Drive Motor.

- 9.1.2.4 Wipe receiver with clean dry rag.
- 9.1.2.5 Inspect receiver for cracked, broken or missing parts.
- 9.1.2.6 Verify Drive Shaft Retaining Ring is in position.
- 9.1.2.7 Inspect Locking Lugs for burrs visually and by running fingers over lugs.
- 9.1.2.8 Inspect Track Latch Handle.
- 9.1.2.9 Inspect electrical connector for corrosion, bent or broken pins.
  - 9.1.2.9.1 Remove corrosion using dry bristle brush.

CAUTION

Do not bend or break connector pins.

- 9.1.2.10 Inspect receiver for proper safety wiring.
- 9.1.2.11 Verify red ring on Reservoir Piston Rod is in view.
- 9.1.2.12 Verify Drive Motor securely attached.
- 9.1.2.13 Lubricate Rocker Assembly, Drive Shaft Splines, rear track, chain guides and Track Latch Hook with light coat of GMD.
- 9.1.2.14 Lubricate remainder of receiver with clean rag dampened in LSA/CLP.

- 9.1.3 Track and Bolt Assembly. Clean, inspect, lubricate.



### WARNING

- o Solvent fumes can burn or poison.
  - o Chain can move and injure fingers. Keep track assembly level, and keep fingers from between chain and sprockets.
- 
- 9.1.3.1 Perform track and bolt disassembly procedure.
  - 9.1.3.2 Using clean rag and cleaning solvent, clean bolt, bolt carrier, firing pin, firing pin sleeve, and track.
  - 9.1.3.3 Check firing pin tip, spring, and firing pin tang. If any one of these is worn or broken, notify organizational maintenance.
  - 9.1.3.4 Check track assembly for damage to chain drive sprockets, firing pin pawl, and safety pawl. If damage is found, notify organizational maintenance.
  - 9.1.3.5 Check anvil for foreign objects. If object cannot be removed, notify organizational maintenance.

### CAUTION

Grease on face of bolt causes dirt to collect in anvil which could cause main gun misfire.  
Do not lubricate face of bolt.

- 9.1.3.6 Put GMD on clean rag and lightly grease flat surfaces at both sides of track rails.
- 9.1.3.6 Lightly grease outside of bolt carrier.
- 9.1.3.7 Using clean rag, remove excess grease from flat surfaces at both sides of track rails and from outside of bolt carrier.

#### CAUTION

When temperature is below  $-25^{\circ}\text{ F}$  ( $-32^{\circ}\text{ C}$ ), GMD grease can cause track rails, slider, master link, and chain to stick. When temperature is below  $-25^{\circ}\text{ F}$  ( $-32^{\circ}\text{ C}$ ), use LAW lubricating oil instead of GMD grease on track rails, slider, master link, and chain.

#### NOTE

If temperature is above  $-25^{\circ}\text{ F}$  ( $-32^{\circ}\text{ C}$ ), do step 9.1.3.9. If temperature is below  $-25^{\circ}\text{ F}$  ( $-32^{\circ}\text{ C}$ ) do step 9.1.3.10.

- 9.1.3.9 If temperature is above  $-25^{\circ}\text{ F}$  ( $-32^{\circ}\text{ C}$ ), use brush to put light coat of GMD grease on firing pin, firing pin sleeve, bolt body, cross slot, carrier track, and firing pin pawl.
- 9.1.3.10 If temperature is below  $-25^{\circ}\text{ F}$  ( $-32^{\circ}\text{ C}$ ), use brush to put light coat of LAW lubricating oil on firing pin, firing pin sleeve, bolt body, cross slot, track rails, slider, master link, chain, and safety link.

#### CAUTION

When temperature is below  $-25^{\circ}\text{ F}$  ( $-32^{\circ}\text{ C}$ ), GMD grease can cause bolt lugs to stick. When temperature is below  $-25^{\circ}\text{ F}$  ( $-32^{\circ}\text{ C}$ ), use LAW lubricating oil on bolt lugs instead of GMD grease.

NOTE

If temperature is above -25° F (-32° C), do step 9.1.3.11. If temperature is below -25° F (-32° C), do step 9.1.3.12.

9.1.3.11 If temperature is above -25° F (-32° C), use brush to apply a heavy coat of GMD grease to bolt lugs.

9.1.3.12 If temperature is below -25° F (-32° C), use brush to apply a heavy coat of LAW lubricating oil to bolt lugs.

9.1.4 Barrel - Clean, inspect, lubricate.

9.1.4.1 Use cleaning rod and swab with LSA/CLP to clean the barrel bore. Continue until the swabs come out clean.

9.1.4.2 Inspect barrel for loose muzzle brake.

9.1.4.3 Verify muzzle brake retaining pin in place.

9.1.4.4 Sight through barrel from chamber end and verify barrel not bent.

9.1.4.5 Verify barrel round count using weapon data book.

NOTE

If round count is above 13,000 rounds, notify organizational maintenance.

9.1.4.6 Visually inspect barrel bearings burrs and scars.

9.1.4.7 Use clean rags dampened with LSA/CLP and soft bristle brush to clean bearings.

9.1.4.8 Grease bearing with GMD using a brush.

9.1.4.9 Wipe down barrel with a light coat of LSA/CLP.

## 9.2 CLEAN, INSPECT, LUBRICATE M240 COAX

### CAUTION

Do not use gasoline, kerosene, hydraulic oil, benzene, benzol, or high pressure water, steam, or air for cleaning the M240.

- 9.2.1 Perform M240 coax disassembly procedure.
- 9.2.2 Run a bore cleaning brush through bore to remove dirt or burned powder.
- 9.2.3 Run a swab soaked with LSA/CLP through bore until the bore is clean.
- 9.2.4 Use chamber brush, swabs, and LSA/CLP to clean gun chamber.
- 9.2.5 Check gas cylinder for carbon buildup. If gas cylinder has carbon buildup notify organizational maintenance.
- 9.2.6 Use swab and LSA/CLP with a receiver cleaning brush to remove powder fouling from the receiver.
- 9.2.7 Use clean, dry cloth to wipe buffer.
- 9.2.8 Move feed lever and cover labels to check spring tension.
- 9.2.9 Look for bent or worn parts.
- 9.2.10 Check flash suppressor for cracks, dents, tightness, burrs, and wear.
- 9.2.11 Check barrel adapter for cracks, dents, tightness, burrs, and wear.
- 9.2.12 Check barrel release lever for cracks, dents, tightness, burrs, and wear.
- 9.2.13 Pull charging handle to make sure charger assembly moves freely.
- 9.2.14 Look for bends, cracks, burred, or chipped rails.
- 9.2.15 Check for broken grips on trigger assembly.
- 9.2.16 Check assembly for bent cable guide on trigger assembly.
- 9.2.17 Check assembly for loose nut and bolt on trigger.
- 9.2.18 Check assembly for chipped or cracked trigger frame holding lug.
- 9.2.19 Check for loose or dirty solenoid.

- 9.2.20 Check trip lever and sear for damage, burns, cracks, chips, and wear.
- 9.2.21 Check cocking of the gun, move trip lever forward to see if sear lifted.
- 9.2.22 Position safety to S (safe).
- 9.2.23 Pull trigger, sear must not lower.
- 9.2.24 Position safety to F (fire).
- 9.2.25 Pull trigger, sear must lower.
- 9.2.26 Check operating rod, bolt, and drive spring for damage.
- 9.2.27 Press the roller to make sure it retracts.
- 9.2.28 Check electrical connectors for damage.
- 9.2.29 Check to be sure there are no bent prongs.
- 9.2.30 Lightly oil sliding parts by moving feed lever.
- 9.2.31 Lightly oil all rails.
- 9.2.32 Lightly oil the trip lever and sear surfaces.
- 9.2.33 Lightly oil roller post.
- 9.2.34 Lightly oil axis pins.
- 9.2.35 Lightly oil all polished parts of the piston extension.
- 9.2.36 Lightly oil primary extension ramps, feed roller surface, and driving spring.

NOTE

Do not oil top or face of bolt.

- 9.2.37 Wipe outside of barrel with lightly oiled rag and run a lightly oiled patch through the bore.
- 9.2.38 Perform M240 coax assembly procedure.
- 9.2.39 Perform M240 coax function check.
- 9.3 PERFORM M257 GRENADE LAUNCHER PM.
  - 9.3.1 Perform turret power-down procedure.
  - 9.3.2 Remove rubber caps from grenade launcher tubes (if launcher tubes are loaded with smoke grenades perform grenade downloading procedure).
  - 9.3.3 Verify launcher tubes are free of dirt and trash.

- 9.3.4 Clear drain hole at bottom of each launcher tube with probe or small piece of wire.
- 9.3.5 Clean inside of grenade launcher tube using M242 main gun bore brush and LSA/CLP.

CAUTION

Do not use gasoline, kerosene, hydraulic oil, benzene, benzol, or high pressure water, steam, or air for cleaning the M257.

- 9.3.6 Dry grenade launcher tubes with clean rags.
- 9.3.7 Verify firing contacts are clean and not damaged.
- 9.3.8 Verify grenade launcher tubes are not bent or dented.
- 9.3.9 Verify grenade launcher tubes are secure on turret armor plate.
- 9.3.10 Install rubber caps on grenade launcher tubes.

9.4 PERFORM PM ON OPTICS.

- 9.4.1 Remove M27 periscopes.
- 9.4.2 Inspect periscopes for discoloration, interior moisture or cracks which could affect visibility. Report discrepancies to organizational maintenance.
- 9.4.3 Inspect periscope mount rubber seals for cracks, nicks, or dryness. Replace as necessary.
- 9.4.4 Replace M27 periscopes.
- 9.4.5 Remove M36E1 day/nightights (gunner's and commander's).
- 9.4.6 Inspect daysight and nightsight front lenses and rear lenses for dirt or moisture which could affect visibility. Report discrepancies to organizational maintenance.
- 9.4.7 Wipe interior of M119 sight mount with dry rag.
- 9.4.8 Install M36E1 day/nightights.
- 9.4.9 Inspect all control knobs and collars on the M36E1 for smooth movement.
- 9.4.10 Wipe clean all outside surfaces of the M36E1.

- 9.4.11 Operate sight shield operating handle checking for smooth operation.
- 9.4.12 Inspect sight shield housing spring for wear (stretching). Replace as necessary.
- 9.5 PERFORM PM ON WIRING HARNESSSES.
  - 9.5.1 Check wiring harnesses for frayed wires and corroded, damaged, or disconnected connections. Report discrepancies to organizational maintenance.
- 9.6 PERFORM PM ON HYDRAULIC SYSTEM.
  - 9.6.1 Check hydraulic fluid at sight gage. Gage should indicate full. Fill with MIL-H-46170 hydraulic fluid as necessary.
  - 9.6.2 Check pop-up indicator on the hydraulic fluid filter assembly. If pop-up indicator is up, the filter should be replaced. Notify organizational maintenance.
  - 9.6.3 Check hydraulic lines, connections and components for leaks. If leaks are found, notify organizational maintenance.
- 9.7 PERFORM PM ON FIRE CONTROL EQUIPMENT.
  - 9.7.1 Position TURRET POWER circuit breaker to ON.
  - 9.7.2 Hold the LAMP TEST switch in the ON position. All indicator lights should come on. Release switch.
  - 9.7.3 Position Drive Select Lever UP (power mode).
  - 9.7.4 Traverse and elevate using the gunner's and commander's hand controller checking for smooth operation.
  - 9.7.5 Position TURRET POWER circuit breaker to OFF.
  - 9.7.6 Position Drive Select Lever DOWN (manual mode).
  - 9.7.7 Traverse and elevate using the elevation handcrank and the azimuth handwheel checking for smooth operation.

NOTE

Report discrepancies to organizational maintenance.

9.8 PERFORM PM ON DOMELIGHTS.

- 9.8.1 Turn domelights on and make sure they light in the white light, and in the blackout (blue/green light) modes.
- 9.8.2 Wipe domelights with clean dry rag.

9.9 PERFORM PM ON SEATS.

- 9.9.1 Inspect commander's and gunner's seats for rips, tears, holes, and open seams.
- 9.9.2 Make sure seatbelts are securely fastened to the seats.
- 9.9.3 Make sure seat adjustments work properly.
- 9.9.4 Lightly oil seat post.
- 9.9.5 Clean seat with stiff bristle brush.

9.10 PERFORM PM ON TURRET CREW STATIONS.

- 9.10.1 Check for trash and loose items underneath turret platform and around turret crew stations.
- 9.10.2 Make sure all controls and indicators are securely mounted.

CAUTION

Do not use gasoline, kerosene, hydraulic oil, benzene, benzol, or high pressure water, steam or air for cleaning the M257.

9.11 PERFORM PM ON WEAPONS ENCLOSURE BAG.

- 9.11.1 Check weapons enclosure bag zippers for dirt and damage.

NOTE

If weapon enclosure bag is torn, zippers do not move freely, notify organizational maintenance.

- 9.11.2 Wipe bag with clean damp rag.

9.12 PERFORM PM ON M242 MAIN GUN AP AND HE FEED CHUTES.

- 9.12.1 Check main gun AP and HE feed chutes for damage.



- 9.12.2 Check for bent or missing latches or latch pins on AP and HE feed chutes.

NOTE

If latches or latch pins are bent, and cannot be latched in place, notify organizational maintenance.

- 9.12.3 Wipe down AP and HE feed chutes with dry clean rag.

9.13 PERFORM PM ON M242 MAIN GUN AP AND HE LINK EJECTION CHUTES.

- 9.13.1 Visually check main gun AP and HE link ejection chutes for damage.
- 9.13.2 Visually check for bent or missing latches or latch pins on AP and HE link ejection chutes.

NOTE

If latches or latch pins are bent and cannot be latched in place, notify organizational maintenance.

- 9.13.3 Wipe down AP and HE link ejection chutes with dry clean rag.

9.14 PERFORM PM ON M240 COAX FEED CHUTE.

- 9.14.1 Check coax feed chute for damage.
- 9.14.2 Check for bent or missing latches or latch pins on coax feed chute.

NOTE

If latches or latch pins are broken or bent and feed chutes cannot be latched in place, notify organizational maintenance.

9.14.3 Wipe down feed chute with dry, clean rag.

9.15 PERFORM PM ON M240 COAX LINK EJECTION CHUTE.

9.15.1 Check coax link ejection chute for damage.

9.15.2 Check for bent or missing latches or latch pins on coax link chute.

NOTE

If latches or latch pins are broken or bent and link chute cannot be latched in place, notify organizational maintenance.

9.15.3 Wipe down link ejection chute with dry, clean rag.

10. PERFORM REMOVAL AND INSTALLATION PROCEDURES

10.1 PERFORM M242 MAIN GUN REMOVAL PROCEDURE.

10.1.1 Barrel

- 10.1.1.1 Traverse turret so that barrel is over front of vehicle.

WARNING

Traversing with power requires alarm "TRAVERSING."

- 10.1.1.2 Turn TURRET POWER circuit breaker switch OFF.  
10.1.1.3 Turn WEAPON POWER circuit breaker switch OFF.  
10.1.1.4 Verify indicators not lit.  
10.1.1.5 Lock TURRET DRIVE LOCK to LOCK.  
10.1.1.6 Place weapon manual safety on SAFE (crosswise).  
10.1.1.7 Press and hold 25mm barrel latch in bottom of rotor extension.

WARNING

If barrel is hot, use asbestos gloves.

- 10.1.1.8 Rotate barrel counterclockwise 1/4 revolution until it reaches a hard stop.  
10.1.1.9 Pull barrel out of receiver.

WARNING

Barrel weighs 89 pounds and will require two people to lift it.

10.1.2 Feeder

- 10.1.2.1 Position TURRET at 400 mils azimuth.

WARNING

Traversing with power requires alarm "TRAVERSING."

- 10.1.2.2 Turn TURRET POWER circuit breaker OFF.
- 10.1.2.3 Turn WEAPON POWER circuit breaker OFF.
- 10.1.2.4 Lock TURRET DRIVE LOCK to LOCK.
- 10.1.2.5 Unzip the weapons enclosure bag.
- 10.1.2.6 Place M242 manual safety on SAFE (crosswise).
- 10.1.2.7 Open Gunner's Sight Shield.
- 10.1.2.8 Disconnect AP and HE feed chutes from feeder.
- 10.1.2.9 Remove AP and HE link chutes.
- 10.1.2.10 Rotate drive shaft knob until bolt position indicator is in SEAR.
- 10.1.2.11 Press drive shaft button and pull drive shaft knob down approximately 3 inches.
- 10.1.2.12 Use manual elevation handcrank to position gun at approximately 15° elevation.
- 10.1.2.13 Press and rotate feeder handle up.

WARNING

Feeder may fall off receiver when feeder handle is rotated.

- 10.1.2.14 Slide feeder off receiver.

WARNING

Feeder weighs 54 pounds and may require two people to lift it.

- 10.1.2.15 Press DRIVE SHAFT Button in center of Drive Shaft knob, push Drive Shaft knob in as far as it will go, then release lock button.

10.1.3 Receiver.

- 10.1.3.1 Turn TURRET POWER and WEAPON POWER circuit breakers OFF.
- 10.1.3.2 Position TURRET DRIVE LOCK to LOCK.
- 10.1.3.3 Place M242 manual safety on SAFE (crosswise).
- 10.1.3.4 Perform barrel removal procedure.
- 10.1.3.5 Perform feeder removal procedure.
- 10.1.3.6 Verify drive shaft locked in place.
- 10.1.3.7 Disconnect electrical connector from receiver.
- 10.1.3.8 Verify that gun is at approximately 15° elevation.
- 10.1.3.9 Rotate red locking handle on gun mount towards center of turret.
- 10.1.3.10 Rotate receiver counterclockwise approximately 35° and pull from gun mount.

WARNING

Receiver weighs 92 pounds and will require two people to lift it.

10.1.4 TRACK AND BOLT ASSEMBLY REMOVAL.

- 10.1.4.1 Perform Feeder Removal Procedure.
- 10.1.4.2 Push in drive shaft knob lock button and pull drive shaft handle down.
- 10.1.4.3 Push up and hold sear release, and turn drive knob handle until bolt moves to rear of main gun receiver, then moves forward (approximately 1/2 inch from outside edge of chain) until sear assembly is between chain links.
- 10.1.4.4 Move track latch handle to the straight out position.
- 10.1.4.5 Using both hands, lift track and bolt assembly out of main gun receiver and place on smooth clean surface.

#### WARNING

Chain can move in sprockets and cause injuries.  
Use care when removing track and bolt assembly.

#### 10.1.5 TRACK AND BOLT DISASSEMBLY.

#### WARNING

Chain can move and injure fingers in sprockets.  
Do not lift assembly off work surface during  
disassembly. Keep fingers clear of chain.

- 10.1.5.1 Turn forward left sprocket clockwise to move carrier to rear of track while pulling carrier back and up slowly.
- 10.1.5.2 Pull bolt carrier free when slider reaches either cross slot.
- 10.1.5.3 To unlock bolt from forward locking position, use cleaning rod to push firing pin tong toward rear of bolt carrier. Bolt should then move freely in bolt carrier.
- 10.1.5.4 Place bolt head on edge of work surface with ejector off of work surface.
- 10.1.5.5 Push down on firing pin sleeve.
- 10.1.5.6 Using fingertips, remove firing pin sleeve keeper.
- 10.1.5.7 Pull firing pin sleeve up and out of bolt.

#### CAUTION

Firing pin sleeve is small and can be lost.  
Handle firing pin sleeve keeper with care.

- 10.1.5.8 Pull firing pin assembly out of bolt.
- 10.1.5.9 Turn bolt carrier over and remove cam pin.
- 10.1.5.10 Remove bolt from bolt carrier.

10.2 PERFORM M242 MAIN GUN INSTALLATION PROCEDURE.

10.2.1 TRACK AND BOLT ASSEMBLY.

- 10.2.1.1 Slide bolt into bolt carrier with cam pin hole facing up.
- 10.2.1.2 Align cam pin hole with cam pin slot, and push cam pin into cam pin hole until it is fully seated in bolt.
- 10.2.1.3 Place bolt head on work surface with ejector off work surface.
- 10.2.1.4 Slide firing pin into bolt with firing pin tang facing rear.
- 10.2.1.5 Install firing pin sleeve over firing pin and into bolt.
- 10.2.1.6 Clean firing pin sleeve keeper with clean rag.

CAUTION

Firing pin sleeve keeper is small and can be lost.  
Handle firing pin sleeve key with care.

- 10.2.1.7 Insert and press firing pin sleeve keeper into hole in bolt.
- 10.2.1.8 Push down on rear of firing pin sleeve until firing pin sleeve keeper pops into hole.
- 10.2.1.9 Pull bolt all the way to forward position until firing pin tang locks.
- 10.2.1.10 Turn forward left sprocket until slider on chain master link is near rear right sprocket.

WARNING

Chain can move and injure fingers. Keep track assembly level, and keep fingers from between chain and sprockets.

- 10.2.1.11 Hold chain and forward left sprocket with left hand. Do not let chain move.

- 10.2.1.12 Place cross slot of bolt carrier over slider.
- 10.2.1.13 Twist bolt carrier toward rails. The bolt guide on bottom front of bolt should slip into track.

## 10.2.2 PERFORM MAIN GUN TRACK AND BOLT ASSEMBLY INSTALLATION.

### NOTE

Track and bolt assembly installation procedure is the same whether the receiver is installed in gun mount or on work bench.

- 10.2.2.1 Push in drive shaft knob lock button and pull drive shaft handle down.
- 10.2.2.2 Push track latch handle to the out position.
- 10.2.2.3 Turn forward left sprocket counterclockwise until rear of bolt carrier is about 1/2 in. from outside edge of chain.

### WARNING

Keep fingers from between sprocket and chain.  
Chain can move and injure fingers.

- 10.2.2.4 Hold forward left sprocket so chain will not move, and place track and bolt assembly in main gun receiver.
- 10.2.2.5 If chain sear is not between chain links, turn drive shaft knob until chain sear is between chain links.
- 10.2.2.6 Push and wiggle track and bolt assembly until it is seated in main gun receiver.
- 10.2.2.7 Push track latch handle toward receiver as far as it will go.
- 10.2.2.8 Turn drive shaft knob until bolt moves to rear and locks in sear position.



10.2.2.9 Press lock button in center of drive shaft knob, and push drive shaft knob in as far as it will go, then release lock button.

10.2.3 RECEIVER.

10.2.3.1 Turn TURRET POWER and WEAPON POWER circuit breakers OFF.

10.2.3.2 Position TURRET DRIVE LOCK to LOCK.

10.2.3.3 Verify that gun mount is elevated approximately 15°.

10.2.3.4 Clean and lightly lubricate gun mount.

10.2.3.5 Rotate locking handle on gun mount towards center of turret.

10.2.3.6 Place HE (lower) link chute in position on gun mount.

10.2.3.7 Place weapon manual safety on SAFE (crosswise).

10.2.3.8 Rotate receiver so that buffer is on left.

WARNING

Receiver weighs 92 pounds and will require two people to lift it.

10.2.3.9 Insert receiver into gun mount.

10.2.3.10 Rotate receiver clockwise approximately 35°.

10.2.3.11 Rotate locking handle on gun mount away from center of turret.

10.2.3.12 Time the receiver (rotate drive shaft until the bolt is in SEAR position).

10.2.3.13 Connect electrical connector.

10.2.4 FEEDER.

10.2.4.1 Turn TURRET POWER circuit breaker OFF.

10.2.4.2 Turn WEAPON POWER circuit breaker OFF.

10.2.4.3 Position TURRET DRIVE LOCK to LOCK.

10.2.4.4 Open Gunner's Sight Shield.

10.2.4.5 Verify that gun mount is elevated approximately 15°.

- 10.2.4.6 Press receiver drive shaft button and pull drive shaft knob down approximately 3 inches.
- 10.2.4.7 Verify that the feeder has been timed.
- 10.2.4.8 Press and hold feeder handle lock.
- 10.2.4.9 Rotate feeder handle up and lock in place.
- 10.2.4.10 Line up feeder with receiver guide rails and slide feeder forward until feeder handle lines up with receiver.

#### WARNING

Feeder weighs 54 pounds and may require two people to lift it.

- 10.2.4.11 Press and hold feeder handle lock.
- 10.2.4.12 Rotate feeder handle down.
- 10.2.4.13 Release feeder handle lock.
- 10.2.4.14 Push receiver drive shaft knob up to receiver and lock in place.
- 10.2.4.15 Install HE and AP link chutes.
- 10.2.4.16 Disconnect feed chutes from ready box.
- 10.2.4.17 Place gun at 0° to 5° elevation.
- 10.2.4.18 Connect HE feed chute to gun.

#### NOTE

The AP feed chute is longer than the HE.

- 10.2.4.19 Connect AP feed chute to gun.
- 10.2.4.20 Connect HE and AP feed chutes to ready box.
- 10.2.4.21 Install weapons enclosure bag.
- 10.2.4.22 Close Gunner's Sight Shield

#### 10.2.5 BARREL.

- 10.2.5.1 Rotate turret so that barrel is over front of vehicle.

- 10.2.5.2 Turn TURRET POWER circuit breaker OFF.
- 10.2.5.3 Turn WEAPON POWER circuit breaker OFF.
- 10.2.5.4 Position TURRET DRIVE LOCK to LOCK.
- 10.2.5.5 Locate ALIGN arrow stamped into barrel.
- 10.2.5.6 Rotate barrel so that ALIGN arrow is on top.

WARNING

Barrel weighs 89 pounds and will require two people to lift it.

- 10.2.5.7 Insert barrel into breach.
- 10.2.5.8 Rotate barrel clockwise 1/4 turn until barrel clicks into place.
- 10.2.5.9 Verify that the LOCKED arrow is on top of barrel.
- 10.2.5.10 Verify that the barrel is latched by trying to turn it counterclockwise.

10.3 PERFORM M240 COAX REMOVAL, DISASSEMBLY, ASSEMBLY AND INSTALLATION PROCEDURES.

10.3.1 Removal.

- 10.3.1.1 Turn TURRET POWER circuit breaker OFF.
- 10.3.1.2 Turn WEAPON POWER circuit breaker OFF.
- 10.3.1.3 Position TURRET DRIVE LOCK to LOCK.
- 10.3.1.4 Unzip the weapons enclosure bag.
- 10.3.1.5 Disconnect electrical connection from solenoid.
- 10.3.1.6 Pull charging handle to the rear.
- 10.3.1.7 Position manual safety to S (safe).
- 10.3.1.8 Raise cover assembly.
- 10.3.1.9 Remove ammo belt.
- 10.3.1.10 Raise feed tray.
- 10.3.1.11 Visually and physically verify that chamber is empty.
- 10.3.1.12 Remove feed chute.
- 10.3.1.13 Remove link chute.

- 10.3.1.14 Remove gun-cradle securing pin from rear of COAX.
  - 10.3.1.15 Pull and hold cradle release lever.
  - 10.3.1.16 Lift rear of COAX and pull away from cradle mount.
  - 10.3.1.17 Release cradle release lever.
  - 10.3.1.18 Remove COAX from cradle.
- 10.3.2 COAX disassembly procedure.
- 10.3.2.1 Charge, clear (visually inspect chamber), and safe gun.
  - 10.3.2.2 Remove barrel.
    - 10.3.2.2.1 Position safety to S (safe).
    - 10.3.2.2.2 Depress barrel locking latch and hold.

#### WARNING

Wear asbestos gloves if barrel is hot.

- 10.3.2.2.3 Turn barrel release to upright position.
  - 10.3.2.2.4 Remove barrel.
- 10.3.2.3 Position manual safety to F (fire).
- 10.3.2.4 Pull charging handle to rear. Pull trigger and ease bolt forward.
- 10.3.2.5 Depress trigger pin spring and remove pin. Pull trigger and frame assembly down and back. Pull charging handle through cable guide.
- 10.3.2.6 Depress backplate latch.
- 10.3.2.7 Lift and remove backplate.
- 10.3.2.8 Press driving spring in, up, and out.

#### CAUTION

Do not stand behind driving spring during removal.

- 10.3.2.9 Raise cover assembly. Place left hand over backplate opening to catch operating rod and bolt assembly. Pull charging handle back, then pull operating rod and bolt assembly out.
- 10.3.2.10 Close cover. Push out cover hinge spring pin as far as possible with the back of buffer. Remove pin with fingers. Remove cover assembly and feed tray.
- 10.3.3 COAX assembly procedure.
  - 10.3.3.1 Position feed tray and cover assembly; push cover assembly forward; close cover and insert cover hinge spring pin.
  - 10.3.3.2 Slide trigger and frame assembly into place. Insert trigger pin; slide charging handle through cable guide.
  - 10.3.3.3 Open cover assembly. Extend bolt to unlocked position. Pull trigger. Set operating rod and bolt assembly on top of rails (receiver), then push all the way in. Close cover and lock.
  - 10.3.3.4 Insert driving spring into operating rod. Push in fully and lower to set the stud in hole of receiver.
  - 10.3.3.5 Install backplate (buffer) and make sure it latches.

NOTE

Top of buffer should be flush with top of receiver.

- 10.3.3.6 Insert barrel fully into receiver and rotate barrel release latch to downward position to lock.
- 10.3.3.7 Perform function check.

- 10.3.4 COAX installation procedure.
- 10.3.4.1 Turn TURRET POWER circuit breaker OFF.
  - 10.3.4.2 Turn WEAPON POWER circuit breaker OFF.
  - 10.3.4.3 Verify TURRET PWR indicator not lit.
  - 10.3.4.4 Verify WEAPON PWR indicator not lit.
  - 10.3.4.5 Position TURRET DRIVE LOCK to LOCK.
  - 10.3.4.6 Lay COAX in cradle guide channel.
  - 10.3.4.7 Slide COAX forward.
  - 10.3.4.8 Seat rear of COAX in cradle guide channel.
  - 10.3.4.9 Connect link chute.
  - 10.3.4.10 Install and lock gun-cradle securing pin.
  - 10.3.4.11 Connect feed chute.
  - 10.3.4.12 Place the charging handle in the weapons enclosure bag.

NOTE

Ensure charging cable is not in the way.

- 10.3.4.13 Zip the weapons enclosure bag closed.

- 10.3.5 M240 COAX rate of fire adjustment procedure.
- 10.3.5.1 Perform COAX removal procedure.
  - 10.3.5.2 Perform COAX barrel removal procedure.
  - 10.3.5.3 Remove gas regulator collar from the gas port area.
  - 10.3.5.4 Remove gas regulator plug.
  - 10.3.5.5 The gas regulator plug will adjust to one of the three positions. Replace gas regulator plug so that the selected gas inlet hole on the regulator plug faces the barrel.
  - 10.3.5.6 Replace collar.
  - 10.3.5.7 Perform barrel installation procedure.
  - 10.3.5.8 Perform COAX installation procedure.

10.4 PERFORM M36E1 SIGHT (GUNNER'S AND COMMANDER'S) REMOVAL/INSTALLATION PROCEDURES.

10.4.1 Removal procedure.

- 10.4.1.1 Turn AUXILIARY POWER circuit breaker OFF.
- 10.4.1.2 Verify AUXILIARY PWR indicator not lit.
- 10.4.1.3 Release expansion pin lock.
- 10.4.1.4 Rotate expansion pin 90° and remove.
- 10.4.1.5 Remove elevation linkage from elevation arm assembly.
- 10.4.1.6 Disconnect electrical connectors from sight head assembly.
- 10.4.1.7 Remove lamp housing from dovetail slot on sight head assembly.
- 10.4.1.8 Secure nightsight with hand to prevent it from falling.
- 10.4.1.9 Loosen front and rear latches to release nightsight elbow and remove nightsight elbow from sight head assembly.

CAUTION

Exposure of nightsight to sunlight or other bright light will damage image intensifier. Keep shield over objective opening until ready for use.

- 10.4.1.10 Secure daysight with hand to prevent it from falling.

NOTE

If removing gunner's sight, remove coax solid feed chute.

- 10.4.1.11 Disengage left and right latches to release daysight elbow and remove daysight elbow from sight head assembly.

#### CAUTION

Do not permit the elevation arm assembly to snap to a stop when removing sight. Serious damage to equipment may occur.

- 10.4.1.12 Loosen wing nuts and align vertically with slots.
- 10.4.1.13 Pull back on head rest assemblies to avoid interference with sight head assembly.
- 10.4.1.14 Secure sight head assembly with hand to prevent it from falling.
- 10.4.1.15 Release safety latch.
- 10.4.1.16 Remove sight head assembly from sight mounts.
- 10.4.1.17 Install day/nightsight elbows into sight head assembly.
- 10.4.2 Installation procedure (gunner's and commander's).
  - 10.4.2.1 Disengage latches to remove day/nightsight elbows from sight head assembly.
  - 10.4.2.2 Loosen wing nuts and position them vertically to align with slots in sight.
  - 10.4.2.3 Slide head assembly into sight mount. Seat properly. Safety latch should snap into place.

#### NOTE

Ensure that the latch is secure and that heads are properly mounted. Water seals will create resistance to seating.

- 10.4.2.4 Tighten wing nuts.
- 10.4.2.5 Slide daysight elbow into sight head assembly. Seat properly.



- 10.4.2.6 Engage left and right latches to secure daysight elbow.
- 10.4.2.7 Slide nightsight elbow into sight head assembly. Seat properly.

CAUTION

Exposure of nightsight to sunlight or other bright light will damage image intensifier. Keep shield over objective opening until ready for use.

- 10.4.2.8 Engage front and rear latches to secure nightsight elbow.
- 10.4.2.9 Install lamp housing into dovetail slot on sight head assembly.
- 10.4.2.10 Connect electrical connectors to sight head assembly.
- 10.4.2.11 Align elevation linkage to elevation arm assembly.
- 10.4.2.12 Install expansion pin and rotate pin handle 90° to secure.

## 11. PERFORM OPERATOR TROUBLESHOOTING PROCEDURES

### 11.1 TROUBLESHOOT M242 MAIN GUN FAILURE TO FIRE.

- 11.1.1 Verify safety is in FIRE (inline).
- 11.1.2 Verify WEAPON POWER circuit breaker is on.
- 11.1.3 Verify WEAPON PWR indicator is lit.
- 11.1.4 Verify WPN ARM switch is in ARM.
- 11.1.5 Verify MAIN GUN indicator lit.
- 11.1.6 Verify MAIN GUN connector and connector plugs are properly seated.
- 11.1.7 Verify SEAR indicator is lit. If not check bolt position indicator and perform appropriate immediate action.

### 11.2 TROUBLESHOOT M240 COAX FAILURE TO FIRE.

- 11.2.1 Verify manual safety switch in F (Fire).
- 11.2.2 Charge COAX.
- 11.2.3 Verify round in feed tray.
- 11.2.4 Verify WEAPON POWER circuit breaker ON.
- 11.2.5 Verify WEAPON PWR indicator lit.
- 11.2.6 Ensure WPN ARM switch is in ARM.
- 11.2.7 Verify COAX indicator lit.
- 11.2.8 Verify electrical connector is properly seated to the COAX solenoid.
- 11.2.9 Verify COAX is properly lubricated.
- 11.2.10 Check that ammo links are not binding in link chute.
- 11.2.11 Check that feed chute is latched in place at feeder tray and at coax solid feed chute. If necessary latch feed chutes in place.
- 11.2.12 Check to see if ammo is binding in box.
- 11.2.13 Check that feed chute has no binding ammo, broken ammo belt or separated ammo belt. If necessary remove and replace ammo in feed chute.

### 11.3 TROUBLESHOOT M257 GRENADE LAUNCHER FAILURE TO LAUNCH.

- 11.3.1 Verify WEAPON POWER circuit breaker ON.
- 11.3.2 Verify WEAPON PWR indicator lit.
- 11.3.3 Verify LEFT/RIGHT or both SALVO switches are ON.

- 11.3.4 Verify READY indicator lit.
- 11.3.5 If still unable to launch refer to immediate action for GRENADE LAUNCHER failure to LAUNCH.
- 11.4 CYCLE M242 BOLT TO SEAR, FEEDER INSTALLED.
  - 11.4.1 Unlock locking ring on power cable and unplug cable.
  - 11.4.2 Position safety to SAFE (crosswise).
  - 11.4.3 Insert handcrank into manual drive gear hub.
  - 11.4.4 Press in and hold sear release lever.
  - 11.4.5 Turn handcrank clockwise. Let go of sear release lever when bolt position indicator clears MISFIRE position.
  - 11.4.6 When bolt position indicator reaches SEAR position, remove handcrank from manual drive gear hub.
  - 11.4.7 Plug power cable in and secure locking ring.
- 11.5 CYCLE M242 BOLT TO SEAR, FEEDER REMOVAL PROCEDURE.
  - 11.5.1 Perform feeder removal procedure.
  - 11.5.2 Push in drive shaft knob button and turn drive shaft knob in direction of arrow on knob until it stops turning.
    - 11.5.2.1 If drive shaft knob stops turning, go to Step 11.5.3.
    - 11.5.2.2 If drive shaft knob does not stop turning, press hard on upper right tab of sear retractor lever to release sear retractor lever.

NOTE

Bolt will not lock in sear when retractor lever is engaged.

- 11.5.3 Turn drive shaft knob toward opposite direction of arrow on knob.
  - 11.5.3.1 If drive shaft knob does not turn, bolt is locked in SEAR.
  - 11.5.3.2 If drive shaft knob does turn, bolt is not locked in SEAR. Notify organizational maintenance.

11.6 TIME M242.

11.6.1 Time feeder.

11.6.1.1 Perform feeder removal procedure.

11.6.1.2 Place feeder on deck with worm nut shaft accessible to operator.

11.6.1.3 Press in on timer lift rod and turn worm nut shaft counterclockwise. Release timer lift rod after one turn.

11.6.1.4 Continue to turn worm nut shaft until bolt position indicator stops in SEAR position and timer lift rod pops out.

11.6.1.4.1 If timer lift rod does not pop out or bolt position indicator does not stop in SEAR position, notify organizational maintenance.

11.6.2 Time receiver.

11.6.2.1 Perform cycle M242 Bolt to Sear, Feeder Removal Procedure (11.5).

APPENDIX D  
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## APPENDIX E

### DOCUMENTATION OF TASKS REQUIRING TRAINING AND TASKS REQUIRING HANDS-ON TRAINING

#### MISSION ORIENTED LAV TURRET TASK LISTING

1. CONDUCT PLANNING

1.1 RECEIVE AND/OR ISSUE FIVE PARAGRAPH ORDER.

2. PERFORM PRE-OPERATION PROCEDURES

2.1 PERFORM M242 MAIN GUN AP FEED SYSTEM LOADING PROCEDURE.

2.1.1 Turn TURRET POWER circuit breaker OFF.

2.1.2 Verify TURRET PWR indicator not lit.

2.1.3 Turn TURRET DRIVE LOCK to LOCK position.

#### WARNING

Loading procedures requires working from inside of vehicle through the turret opening. To prevent injury to personnel or damage to equipment, ensure that TURRET POWER circuit breaker remains in OFF position and TURRET DRIVE LOCK remains at LOCK position while working through turret opening.

2.1.4 Turn WEAPON POWER circuit breaker OFF.

2.1.5 Verify WEAPON PWR indicator not lit.

2.1.6 Set WEAPON ARM switch to SAFE.

2.1.7 Place M242 manual safety on SAFE (crosswise).

2.1.8 Remove all links from the AP link chute.

2.1.9 Perform feeder removal and installation procedure and verify that the weapon is clear prior to loading ammunition.

2.1.10 Verify that both ends of AP feed chute are latched in place.

2.1.11 Verify that the bolt position indicator pointer is at SEAR.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	
	X
	X
	X
	X
	X
X	
X	
X	X
X	
X	

- 2.1.12 Rotate knob on M242 vertical drive shaft back and forth to verify that the weapon bolt assembly is in SEAR. Drive shaft must meet resistance in both directions.
- 2.1.13 Push feed select solenoid on M242 to AP position (IN).
- 2.1.14 Open AP ammo box cover on forward compartment of ready box.
- 2.1.15 Load AP ammo into the ready box with the projectile toward the Commander's station.
  - 2.1.15.1 Put the double claw end of the belt into the forward section of the compartment (link face down) and fold the belt to fill the compartment.
- 2.1.16 Connect succeeding belts as needed.
- 2.1.17 Route the single-claw end of a belt into the forwarder with the link side up.
- 2.1.18 Use the 14mm ratchet wrench on the forwarder to route the ammo belt up the feed chute.
  - 2.1.18.1 Continue until the lead round is in the upper feed sprocket.
- 2.1.19 Place 14mm wrench on upper feed sprocket extension and rotate in direction of arrow on feeder until the feed chute stop clicks once.

NOTE

If unable to successfully accomplish 2.1.19, return wrench to forwarder and ensure lead round is in the upper feed sprocket.

- 2.1.20 Close AP ammo box cover and secure.
- 2.1.21 Stow 14mm ratchet wrench.
- 2.1.22 Verify that weapons enclosure bag is properly secured around weapons, feed chutes, and top of rotor.
- 2.1.23 Set TURRET DRIVE LOCK to UNLOCK position.
- 2.1.24 Sound alert "POWER." Position TURRET POWER and WEAPON POWER circuit breakers to ON.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	
X	
X	
X	
	X
	X
	X
	X
	X
X	
X	
X	
	X
	X

- 2.1.25 Verify TURRET PWR and WEAPON PWR indicators lit.
- 2.2 PERFORM M242 MAIN GUN HE FEED SYSTEM LOADING PROCEDURE.
- 2.2.1 Turn TURRET POWER circuit breaker OFF.
- 2.2.2 Verify TURRET PWR indicator not lit.
- 2.2.3 Turn TURRET DRIVE LOCK in LOCK position.

WARNING

Loading procedures requires working from inside of vehicle through the turret opening. To prevent injury to personnel or damage to equipment, ensure that TURRET POWER circuit breaker remains in OFF position and TURRET DRIVE remains at LOCK position while working through turret opening.

- 2.2.4 Turn WEAPON POWER circuit breaker OFF.
- 2.2.5 Verify WEAPON PWR indicator not lit.
- 2.2.6 Position WEAPON ARM switch to SAFE.
- 2.2.7 Place M242 manual safety on SAFE (crosswise).
- 2.2.8 Remove all links from the HE link chute.
- 2.2.9 Perform feeder removal and installation procedure and verify that the weapon is clear prior to loading ammunition.
- 2.2.10 Verify that both ends of HE feed chute are latched in place.
- 2.2.11 Verify that the bolt position indicator pointer is at SEAR.
- 2.2.12 Rotate knob on M242 vertical drive shaft back and forth to verify that the weapon bolt assembly is in SEAR. Drive shaft must meet resistance in both directions.
- 2.2.13 Pull the feed select solenoid to HE position (OUT).
- 2.2.14 Remove HE ammo box cover from rear compartment of ready box.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
X	
	X
X	
X	
X	
X	



		TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
2.2.15	Load HE ammo into the ready box with the projectile toward the Commander's station.		X
2.2.15.1	Put the single-claw end of the belt into the forward compartment of the ready box. Fold the belt to fill that compartment (ammo face down). After the front compartment is full, fill the second and rear compartments in sequence.		X
2.2.16	Connect succeeding belts as needed.		X
2.2.17	Route the double-claw end of a belt, with a round in and link side up, into the forwarder.		X
2.2.18	Use the 14mm ratchet wrench on the forwarder to route the ammo belt up the feed chute.		X
2.2.18.1	Continue until the lead round is in the lower feed sprocket.		
2.2.19	Place 14mm wrench on lower feed sprocket extension and rotate in direction of arrow on feeder until the feed chute stop clicks twice.		X
<p style="text-align: center;">NOTE</p> <p>If unable to successfully accomplish 2.2.19, return wrench to forwarder and ensure lead round is in the upper feed sprocket.</p>			
2.2.20	Close HE ammo box cover and secure.	X	
2.2.21	Stow the 14mm ratchet wrench.	X	
2.2.22	Verify that weapons enclosure bag is properly secured around weapons, feed chutes, and top of rotor.	X	
2.2.23	Set TURRET DRIVE LOCK handle to UNLOCK position.		X
2.2.24	Sound alert "POWER." Position TURRET PWR and WEAPON PWR circuit breakers to ON.		X
2.2.25	Verify TURRET PWR and WEAPON PWR indicators lit.		

- | <b>TRAINING<br/>REQUIRED</b> | <b>HANDS-ON<br/>TRAINING<br/>REQUIRED</b> |
|------------------------------|---|
|                              | X   |
|                              | X   |
|                              | X   |
|                              |   |
|                              |   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              |   |
|                              |   |
|                              |   |
|                              | X   |

Loading procedure requires working from inside of vehicle through turret opening. To prevent injury to personnel or damage to equipment, ensure that TURRET POWER circuit breaker remains in OFF position and TURRET DRIVE LOCK remains at LOCK position while working through turret opening.

- Additional ammo belts will be connected, as needed, until ammo box is full.

- E-5

If end of ammo belt from previous loading is folded over ammo forwarder, proceed to step 2.3.17.

- [illegible]

- 2.4.8 Remove and store four protective covers from each launcher.
- 2.4.9 Verify that each launcher barrel is free of contamination and contacts are clear.
- 2.4.10 Insert a grenade in a barrel electrical contacts first.

**WARNING**

When loading L5 smoke grenades, keep your body, head, fingers, etc., out of the direct line of the barrel as the grenade is inserted.

- 2.4.11 Rotate the grenade at least a quarter turn to insure electrical contact.
- 2.4.12 Repeat steps 2.4.10 and 2.4.11 for remaining barrels.
- 2.4.13 Turn TURRET DRIVE LOCK to UNLOCK position.
- 2.4.14 Sound alert "POWER." Turn TURRET POWER and WEAPON POWER circuit breakers to ON position.
- 2.4.15 Verify TURRET PWR and WEAPON PWR indicators lit.

- 2.5 PERFORM DRY FIRE CHECKLIST (M242 MAIN GUN AND M240 COAX) PROCEDURE.
  - 2.5.1 Ensure appropriate vehicle hatches closed and locked.
  - 2.5.2 Place M242 safety to SAFE (crosswise).
  - 2.5.3 Charge M240, set weapon manual safety to S (Safe) position.
  - 2.5.4 Turn TURRET DRIVE LOCK to LOCK position.
  - 2.5.5 Sound alert "POWER"; set TURRET POWER, WEAPON POWER, and AUXILIARY POWER circuit breakers to ON position.
  - 2.5.6 Verify that TURRET PWR, WEAPON PWR and AUX PWR indicators are lit.
  - 2.5.7 Set WEAPON ARM switch to ARM.
  - 2.5.8 Position DRIVE SELECT lever up for power mode.
  - 2.5.9 Position gunner's MAIN/COAX switch to MAIN.
  - 2.5.10 Verify "MAIN" indicator lit.
  - 2.5.11 Verify MAIN GUN "SEAR" indicator lit.
  - 2.5.12 Position gunner's AP/HE switch to AP.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	X
	X
	X
X	
	X
	X
	X
	X
X	
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X



- 2.6 PLACE RADIOS IN OPERATION.  
HS - TBD
- 2.7 PERFORM RADIO TELEPHONE PROCEDURES.  
HS - I D

E-9

### 3. PLACE TURRET IN OPERATION

#### 3.1 PERFORM PRE-MISSION CHECKLIST.

- 3.1.1 Turn TURRET DRIVE LOCK to LOCK position.
- 3.1.2 Check electrical harness for frayed wires and disconnected connectors.
- 3.1.3 Check hydraulic components for leaks.
- 3.1.4 Check hydraulic fluid reservoir level.
- 3.1.5 Check pop-up indicator on hydraulic fluid filter assembly. If up notify organizational maintenance.
- 3.1.6 Check Commander's and Gunner's sights and vision blocks.
- 3.1.7 Check gunner's nightsight power switch off.
- 3.1.8 Check gunner's nightsight RETICLE brightness control off.
- 3.1.9 Check Commander's nightsight power switch off.
- 3.1.10 Check Commander's nightsight RETICLE brightness control off.
- 3.1.11 Boresight knobs and diopter ring checked for movement.
- 3.1.12 Main gun and feed system checked.
  - 3.1.12.1 Main Gun manual safe ON (crosswise).
  - 3.1.12.2 Main Gun in SEAR.
  - 3.1.12.3 Feed Chutes in place.
  - 3.1.12.4 Link Chutes in place and clear.
- 3.1.13 Close and latch A.P. ammo cover.
- 3.1.14 Close and latch H.E. ammo cover.
- 3.1.15 Coax gun and feed system checked.
  - 3.1.15.1 Coax on safe.
  - 3.1.15.2 Feed chute in place.
  - 3.1.15.3 Link chute in place and clear.
- 3.1.16 Radio and intercom off.
- 3.1.17 Adjust seat.

#### 3.2 PERFORM TURRET POWER-UP PROCEDURE.

- 3.2.1 Perform PRE-MISSION CHECKLIST.
- 3.2.2 Turn vehicle MASTER switch on.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
X	
	X
X	
X	
	X
	X
	X
	X
X	
	X
	X
	X
	X
X	
	X
	X
	X
	X
X	
	X
X	

- | TRAINING<br>REQUIRED | HANDS-ON<br>TRAINING<br>REQUIRED |
|----------------------|----------------------------------|
| X                    |                                  |
| X                    |                                  |
| X                    |                                  |
| X                    |                                  |
|                      | X                                |
| X                    |                                  |
|                      | X                                |
|                      |                                  |
|                      |                                  |
|                      | X                                |
|                      | X                                |
|                      |                                  |
|                      |                                  |
|                      |                                  |
| X                    |                                  |
| X                    |                                  |
| X                    |                                  |
| X                    |                                  |

Electrical power is now available to entire turret.

- WARNING

3.2.10 Close palm switch.

3.2.11 Use both hand controls to drive gun and turret.

Turret operators are responsible for gun and bustle overhang during mobile operation.

- E-11



AD-A141 847

LIGHT ARMORED VEHICLE (LAV) TASK AND MEDIA ANALYSIS FOR  
THE US MARINE CORPS LAV-25(U) BAUM CHEMICAL CORP CARSON  
CALIF\* C FAGAN ET AL. 26 AUG 83 C731.08

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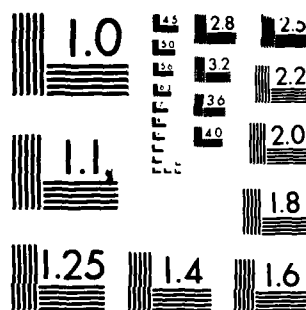
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MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS 1963-A

		TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
3.3.5	Perform ICS and radio checks.		X
3.3.6	Turn vent switch on to check vent operation.	X	
3.3.7	Position DRIVE SELECT lever down for manual mode.		X
3.3.8	Rotate elevation handcrank to move guns up and down.		X
3.3.9	Rotate azimuth handwheel to rotate turret clockwise and counterclockwise.		X
3.3.10	Position DRIVE SELECT lever up for POWER mode.		X
3.3.11	Perform CDU Lamp Test.		X
3.3.12	Close Gunner's palm switch.		X
3.3.13	Verify hydraulic pump operating.		X
3.3.14	Elevate Main gun from Gunner's hand control.		X
3.3.15	Traverse Turret from Gunner's hand control.		X
3.3.16	Elevate Main gun from Commander's hand control.		X
3.3.17	Traverse Turret from Commander's hand control.		X
3.3.18	Turn WEAPON POWER circuit breaker ON.		X
3.3.19	Verify WEAPON PWR indicator lit.		X
3.3.20	Set WPN ARM switch to ARM.		X
3.3.21	Perform DRY FIRE CHECKLIST.		X
3.3.22	Perform STAB OPERATING PROCEDURE.		X
3.4	PERFORM M242 MAIN GUN CYCLING PROCEDURE		
3.4.1	Perform M242 uploading procedures (2.1 and 2.2).		X
3.4.2	Place M242 safety to SAFE (crosswise).		X
3.4.3	Sound alert "POWER"; set TURRET POWER, WEAPON POWER and AUX POWER circuit breakers to ON position.		X
3.4.4	Verify that TURRET POWER, WEAPON POWER and AUX POWER indicators are lit.		X
3.4.5	Set WEAPON ARM switch to ARM.		X
3.4.6	Position DRIVE SELECT lever up for power mode.		X
3.4.7	Position gunner's MAIN/COAX switch to MAIN.		X
3.4.8	Verify "MAIN" indicator is lit.		X
3.4.9	Verify MAIN GUN "SEAR" indicator is lit.		X
3.4.10	Position gunner's AP/HE switch to AP.		X
3.4.11	Verify "AP" indicator is lit.		X

- | TRAINING<br>REQUIRED | HANDS-ON<br>TRAINING<br>REQUIRED |
|----------------------|----------------------------------|
|                      | X                                |
|                      | X                                |
|                      | X                                |
|                      | X                                |
|                      | X                                |
|                      | X                                |
|                      | X                                |
|                      | X                                |
|                      | X                                |
| X                    |                                  |
| X                    |                                  |
|                      | X                                |
|                      |                                  |
|                      | X                                |
|                      | X                                |
| X                    |                                  |
|                      | X                                |

Main Gun is now ready to fire. Place safety on FIRE when ready to continue engagement.

- 3.5.1 Locate a target at 1000 meters.
- 3.5.2 Place vehicle on level surface.
- 3.5.3 Install 25mm adapter, boresight device and streamer.
- 3.5.4 Driver looks through boresight device and gives directions to the gunner to lay boresight cross to aiming point of target.
- 3.5.5 Gunner moves gun manually as directed by driver.
- 3.5.6 Driver rotates boresight device 180° degrees to check boresight alignment.

Personnel in or on LAV should remain stationary during boresight alignment.

- E-13



- 3.6.15 Using manual elevation handcrank and traversing handwheel, relay gunner's boresight cross on an identifiable aiming point.
- 3.6.16 Using boresight knobs, adjust commander's M-36E1 boresight cross to the same identifiable aiming point as gunner's boresight cross is on.
- 3.6.17 Record boresight knob setting, ammo, and range, in vehicle logbook.
- 3.7 PERFORM M-240 COAX BORESIGHT PROCEDURE.

NOTE

During the procedure, DO NOT move the boresight knobs.

- 3.7.1 Perform M242 boresight alignment procedure.
- 3.7.2 Perform M242 zeroing procedure.
- 3.7.3 Place vehicle on level surface.
- 3.7.4 Locate a target at Known Range (recommended 800 meters).
- 3.7.5 Perform Main gun Clearing procedure.
- 3.7.6 Install 7.62mm adapter, boresight device and streamer into muzzle of coax.
- 3.7.7 Move gun manually to lay the gunner's M36E1 boresight cross on an identifiable target aiming point.
- 3.7.8 Driver looks through boresight device and uses 14mm ratchet wrench on COAX mount boresight drive nuts to adjust deflection and elevation to the selected aiming point of the M36E1 boresight cross.

CAUTION

Deflection must be adjusted before elevation due to the configuration of the gun mount.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
X	
	X
	X
X	
X	
	X
	X

3.7.9 Remove 7.62 adapter, boresight, device and streamer and  
stow in proper compartment.

NOTE

COAX is now boresighted.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED

#### 4. OPERATE THE TURRET

4.1 PERFORM M242 MAIN GUN PRE-FIRE CHECKLIST PROCEDURES (POWERED DRIVE).

- 4.1.1 Verify appropriate vehicle hatches closed and locked.
- 4.1.2 Turn AUXILIARY POWER circuit breaker ON.
- 4.1.3 Verify AUX PWR indicator lit.
- 4.1.4 Place safety to FIRE (inline).
- 4.1.5 Position DRIVE SELECT lever up for power mode.
- 4.1.6 Turn TURRET POWER circuit breaker ON.
- 4.1.7 Verify TURRET PWR indicator lit.
- 4.1.8 Position appropriate MAIN/COAX switch MAIN.
- 4.1.9 Verify MAIN GUN indicator lit.
- 4.1.10 Turn WEAPON POWER circuit breaker ON.
- 4.1.11 Verify WEAPON PWR indicator lit.
- 4.1.12 Set WEAPON ARM switch to ARM.
- 4.1.13 Verify appropriate LOW AMMO indicator not lit.
- 4.1.14 Verify MAIN GUN "SEAR" indicator lit.
- 4.1.15 Position AP/HE switch as appropriate.
- 4.1.16 Verify appropriate AP/HE indicator lit.
- 4.1.17 Position 200/100/SS switch as appropriate.
- 4.1.18 Verify appropriate 200/100/SS indicator lit.

### NOTE

**Weapon ready to fire from hand control.**

**4.2 PERFORM M242 MAIN GUN PRE-FIRE CHECKLIST PROCEDURES (MANUAL DRIVE).**

- 4.2.1 Verify appropriate vehicle hatches closed and locked.
- 4.2.2 Position AUXILIARY POWER circuit breaker to ON.
- 4.2.3 Verify AUX PWR indicator lit.
- 4.2.4 Place safety to FIRE (inline).
- 4.2.5 Position DRIVE SELECT lever down for manual mode.
- 4.2.6 Position appropriate MAIN/COAX switch MAIN.
- 4.2.7 Turn WEAPON POWER circuit breaker ON.

[illegible]



- ### NOTE

#### 4.3 PERFORM M240 COAX PRE-FIRE CHECKLIST PROCEDURES (POWERED DRIVE).

- ### NOTE

**Weapon ready to fire from hand control.**

E-18



# NOTE

If LOS drifts more than 5 mils in 15 sec in azimuth or elevation perform LOS DRIFT COMPENSATION procedure.

## 4.6 PERFORM M36E1 DAYSIGHT OPERATING PROCEDURE.

4.6.1 Adjust seat height for use of daysight.

# WARNING

Do not aim sight at sun. Serious eye damage may occur.

# CAUTION

The nightsight will be damaged if exposed to daylight with the nightsight power switch ON. Before using the M36E1 sight during daylight, make sure nightsight power switch is in OFF position.

4.6.2 Open M119 sight shield by turning sight shield handle clockwise (15°) and pushing up.

4.6.3 Adjust brow pad for proper eye relief.

4.6.4 Sight a distant object through daysight and adjust diopter ring for sharp focus.

4.6.5 Record diopter setting.

4.6.6 Turn AUXILIARY POWER circuit breaker ON.

4.6.7 Verify that AUX PWR indicator lit.

4.6.8 Adjust reticle brightness for personal comfort.

## 4.7 PERFORM LOS DRIFT COMPENSATION PROCEDURE.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	
X	
	X
	X
X	
	X
	X
	X

NOTE

The LOS drift compensation procedure can be used anytime the turret is powered-up to keep the LOS from drifting. If STAB operation is not desired, omit steps 4.7.2 and 4.7.3.

- 4.7.1 Perform TURRET POWER-UP procedure.
- 4.7.2 Turn STAB switch ON.
- 4.7.3 Verify STAB ON indicator lit.
- 4.7.4 Verify that STAB AZ and EL indicators not lit..
- 4.7.5 Close palm switch (keep hand control in neutral).
- 4.7.6 If LOS drifts more than 5 mils in 15 sec., adjust STAB AZ and/or EL DRIFT knobs as required until LOS azimuth drift is less than 5 mils in 15 sec.

4.8 PERFORM M36E1 NIGHTSIGHT OPERATING PROCEDURE.

- 4.8.1 Loosen front and rear latches securing nightsight elbow to M36E1 sight assembly and remove elbow from sight assembly.
- 4.8.2 Remove and store rubber cover from nightsight elbow.
- 4.8.3 Position nightsight elbow on M36E1 sight assembly and secure with front and rear latches.
- 4.8.4 Turn AUXILIARY POWER circuit breaker ON.
- 4.8.5 Verify AUX PWR indicator lit.

CAUTION

Do not turn nightsight power switch ON during daylight. Exposure to bright light can damage image intensifier tube.

- 4.8.6 Turn nightsight elbow power switch (on right side of elbow) ON.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
X	
	X
	X
	X



5. PERFORM TARGET ACQUISITION

5.1 SELECT/OCCUPY OBSERVATION POSITIONS.

5.1.1 When moving use turret-down or hull-down routes.

5.1.2 When stationary use:

5.1.2.1 Cover/concealed turret down positions with  
dismounted observer.

5.1.2.2 Cover/concealed hull-down positions.

5.2 ASSIGN TARGET AREA RESPONSIBILITIES.

5.2.1 VC: look for likely targets within assigned sector of  
responsibility.

5.2.2 Gunner: look for likely targets within assigned sector of  
responsibility.

5.3 SCAN FOR TARGETS.

5.3.1 Without optics make quick overall search for obvious  
targets.

5.3.2 With optics make detailed search of terrain using 50 meter  
method.

5.3.2.1 Search a strip 50 meters deep from right to  
left.

5.3.2.2 Then search from left to right farther out  
overlapping the first strip.

5.3.2.3 Continue until entire section is covered.

5.3.2.4 When a suspicious spot is detected, stop and  
search it thoroughly.

5.3.3 Search from far to near when suspecting air threat.

5.4 PERFORM NIGHT ACQUISITION.

5.4.1 Scan with off-center vision with short, abrupt, irregular  
eye movements. Pause a few seconds to detect any motion  
at each likely target.

5.4.2 Listen for sounds and smell for odors.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	
X	
X	
X	
X	
X	
X	
X	
X	
X	
X	
X	
X	

- 5.4.3 Use night vision devices (passive).
- 5.5 SCAN FOR TARGET IDENTIFICATION.
- 5.5.1 Identify target as friend or foe.
- 5.5.2 Rank threat as:
- 5.5.2.1 Most dangerous.
- 5.5.2.2 Dangerous.
- 5.5.2.3 Least dangerous.
- 5.5.3 Acquisition reports:
- 5.5.3.1 Who is reporting?
- 5.5.3.2 Target description.
- 5.5.3.3 Where the target is.
- 5.5.3.4 What the target is doing.

NOTE

If time permits, proceed with 5.5.4.

- 5.5.4 SALUTE
- 5.5.4.1 Size.
- 5.5.4.2 Activity.
- 5.5.4.3 Location.
- 5.5.4.4 Unit.
- 5.5.4.5 Time.
- 5.5.4.6 Equipment.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	.
	X
X	
X	
X	
X	
X	
X	

[illegible]

- 6.1.1 Commander announces the Alert.
- 6.1.2 Commander announces the type of Ammunition and rate of fire.
- 6.1.3 Commander announces target description.
- 6.1.4 Commander announces the direction in which to slew the turret. (This step may be omitted.)
- 6.1.5 Commander announces the approximate range of the target. (This step may be omitted.)
  - 6.1.5.1 Commander slews turret in direction indicated.
  - 6.1.5.2 Gunner announces "IDENTIFIED" when he sees the TARGET. (This step will occur the instant the gunner sees the target.)

Once Gunner announces "IDENTIFIED," Commander releases the override of the gun, and turns control of the gun to the gunner. Once Gunner has control of the gun he makes a precision lay of the gun.

- |       |                                   |   |
|-------|-----------------------------------|---|
| 6.1.6 | Commander announces "FIRE."       | X |
| 6.1.7 | Commander announces "ON THE WAY." | X |
| 6.1.8 | Gunner announces "CEASE FIRE."    | X |

**6.2.1 Acquire target within the sight's field of view.**



- 6.2.2 Determine range utilizing stadia reticle or the most accurate means available.
- 6.2.3 Determine the type of ammunition. Range numbers on the left side of reticle are used for HE and TP ammunition. AP range is identified on the right side of reticle.
- 6.2.4 Determine the sighting point on the reticle. Select the point on the range line that corresponds to the range determined in step 2 and the type of ammunition selected in step 3.
- 6.2.5 Determine cross range velocity. Cross range velocity is defined as movement of the target or vehicle perpendicular to the line of fire. If cross range velocity is zero, the gun is now aimed. If it is not zero, then a lead angle must be developed.
- 6.2.6 Determine lead angle direction. Using your vehicle as reference, determine whether the target vehicle is moving to your right or left. Move the sighting point in the direction of target movement.
- 6.2.7 Determine lead angle. Using the estimated cross range velocity, apply lead angle as appropriate from the lead angle table.

LEAD ANGLE TABLE		
CROSS RANGE VELOCITY	LEAD ANGLE IN MILLS	
Miles Per Hour	AP	HE
5 MPH	2	3
15 MPH	05	08
30 MPH	11	16
50 MPH	18	27

- 6.2.8 Determine the sighting point on the reticle. Move the sighting point (step 4) in the lead angle direction (step 6) by the amount of mils in the lead angle (step 7).
- 6.2.9 FIRE on command.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	X
	X
	X
	X
	X

6.3 APPLY BATTLESIGHT FIRING TECHNIQUE.

6.3.1 Prepare for battlesight firing technique

- 6.3.1.1 Determine the most likely targets to be engaged.
- 6.3.1.2 Determine the type of ammunition to be fired.
- 6.3.1.3 Select the designated ammunition.
- 6.3.1.4 Cycle the M242 Main Gun in order to load the gun.
- 6.3.1.5 Set M242 Main gun safety to FIRE (inline).
- 6.3.1.6 Set WPN ARM switch to SAFE.

6.3.2 Acquire the target

6.3.3 Using choke reticle, determine appropriate range for ammunition selected.

6.3.4 Determine that target is in Battlesight range.

6.3.5 Issue fire command.

6.3.5.1 Commander announces "GUNNER," and slews turret in direction of target.

6.3.5.2 Commander announces "BATTLESIGHT."

6.3.5.3 Gunner sets WPN ARM switch to ARM

6.3.5.4 Commander announces the description of target (e.g., BMP, Troop, Tank).

6.3.5.5 Gunner announces "IDENTIFIED."

6.3.5.6 Commander releases hand control.

6.3.5.7 Commander announces "FIRE."

6.3.5.8 Gunner makes final lay of gun, announces "ON THE WAY," and FIRES.

6.3.5.9 Commander announces "CEASE FIRE."

6.4 PERFORM SENSING AND BURST ON TARGET ADJUSTMENT.

6.4.1 Gunner calls out range sensings: short, over, target, doubtful or lost (gunner).

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	
	X
	X
	X
	X
X	
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X

		TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
6.4.2	Employ burst on target for direct fire adjustment:		
6.4.2.1	Fire 3 to 5 round burst.		X
6.4.2.2	Adjust center of impact to center of mass of target.		X
6.4.2.3	For moving targets using BOT, track continuously before, during and after firing (gunner)		X
NOTE			
If burst on target not possible, Commander issues subsequent fire command.			
6.4.3	Issue subsequent fire command, if necessary (Vehicle Commander)		X
6.4.3.1	Alert (SHORT, OVER, ON TARGET, LOST, DOUBTFUL)		X
6.4.3.2	Deflection correction (When given, it is LEFT or RIGHT by specified number of miles).		X
6.4.3.3	Range correction (Add or drop by number of meters)		X
6.4.3.4	Execution (FIRE)		X
6.4.3.5	Corrections (Repeat 6.4.3.1 through 6.4.3.4)		X
6.4.3.6	Target (Describe target)		X
6.4.3.7	Cease fire		X
6.5	ENGAGE TARGETS WITH M242 MAIN GUN CANNON.		
6.5.1	Estimate range to target.		X
6.5.2	Estimate speed of moving target.		X
6.5.3	Move controls to correct aim point.		X
6.5.4	Fire M242 at stationary target from stationary vehicles.		X
6.5.5	Fire M242 at stationary target from moving vehicle.		X
6.5.6	Fire M242 at moving target from stationary vehicle.		X
6.5.7	Fire M242 at moving target from moving vehicle.		X
6.5.8	Adjust rounds to target using burst-on-target (BOT) method.		X

6.6 ENGAGE TARGETS WITH M240 COAX MACHINE GUN.

- 6.6.1 Estimate range to target.
- 6.6.2 Estimate speed of moving target.
- 6.6.3 Move controls to correct aim point.
- 6.6.4 Fire M240 at stationary target from stationary vehicle.
- 6.6.5 Fire M240 at stationary target from moving vehicle.
- 6.6.6 Fire M240 at moving target from stationary vehicle.
- 6.6.7 Fire M240 at moving target from moving vehicle.

6.7 EMPLOY M257 GRENADE LAUNCHER.

WARNING

Crew should be in vehicle and all hatches closed when firing grenade launcher.

- 6.7.1 Turn WEAPON POWER circuit breaker ON.
- 6.7.2 Verify WEAPON PWR indicator lit.
- 6.7.3 Turn either or both salvo switches on.
- 6.7.4 Verify GRENADE LAUNCHER READY INDICATOR lit.
- 6.7.5 Lift fire switch guard and push up on fire toggle switch.
- 6.7.6 Turn either or both salvo switches off.
- 6.7.7 Verify that ready indicator not lit.

6.8 SELECT AND OCCUPY FIRING POSITIONS.

- 6.8.1 Primary Position - Position LAV to cover most likely enemy avenues of approach.
- 6.8.2 Alternate Position - Position LAV to cover same target areas as primary position.
- 6.8.3 Supplementary Position - Position LAV to cover target areas or enemy routes of advance that cannot be covered from primary or alternate positions (usually flanks or rear).

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
X	
X	
X	

- 6.8.4 Use turret-down positions when observing and acquiring targets.
- 6.8.5 Use hull-down positions for all direct fire gun engagements.
- 6.8.6 Turret-down to hull-down:
  - 6.8.6.1 Move LAV forward slowly (driver).
  - 6.8.6.2 Level the gun and look through optical sight (gunner).
  - 6.8.6.3 Stop LAV where target can be seen without obstruction.
- 6.8.7 Defensive operations:
  - 6.8.7.1 Select covered and concealed positions below the topographical crest and preferably on the sides of a hill to avoid skylining.
  - 6.8.7.2 Avoid swampy areas and hillsides, select positions which are dry and level.
  - 6.8.7.3 Select covered and concealed routes into and out of the position.
  - 6.8.7.4 Avoid selecting positions near or within prominent terrain features.
  - 6.8.7.5 Avoid unnecessary movement and heat and light generation while in positions.
  - 6.8.7.6 Camouflage is continuous.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
X	
X	
X	
X	
X	
X	

## 7. PERFORM IMMEDIATE ACTION PROCEDURES

7.1 STOP RUNAWAY TURRET.

- 7.1.1 Turn TURRET POWER circuit breaker OFF. If Turret does not stop go to Step 7.1.2.
- 7.1.2 Position DRIVE SELECT lever down for manual mode. If Turret does not stop go to Step 7.1.3.
- 7.1.3 Turn VEHICLE MASTER SWITCH to OFF.
- 7.1.4 Turn TURRET DRIVE LOCK to LOCK.

7.2 REDUCE M242 MAIN GUN FAILURE TO FIRE.

- 7.2.1 Verify that M242 safety is in FIRE position (inline).
- 7.2.2 Verify bolt position indicator in SEAR.
- 7.2.3 Verify level of ammunition.
- 7.2.4 If ammunition is exhausted perform ammo uploading procedure.
- 7.2.5 If ammunition is present check
  - 7.2.5.1 Check to see if ammo is binding in box.
  - 7.2.5.2 Check that feed chutes are latched in place at main gun feeder and at ammo box.
  - 7.2.5.3 Check that feed chutes have no binding ammo, broken ammo belt, or separated ammo belt.
  - 7.2.5.4 Check that ammo links are not binding in link ejection chutes. If links are binding, notify organizational maintenance.
- 7.2.6 Attempt to fire weapon. If weapon fires continue mission. If weapon fails to fire, go to 7.2.7.
- 7.2.7 Ensure lead round is in feed sprocket.
  - 7.2.7.1 With 14 mm ratchet wrench, turn ammo forwarder 1/4 turn to forward ammo.

<b>TRAINING REQUIRED</b>	<b>HANDS-ON TRAINING REQUIRED</b>
	.
	X
	X
	X
	X
	X
	X
X	
	X
X	
X	
X	
X	
	X
	X

**NOTE**

To forward AP ammo, turn AP forwarder clockwise.

To forward HE ammo, turn HE forwarder counter-clockwise.

- 7.2.8 If bolt position indicator is not in SEAR and it is before DWELL, place a No. 4 cross point screwdriver on the drive shaft and turn handle clockwise to move bolt position indicator back to SEAR.
- 7.2.9 If bolt position indicator is not in SEAR and is after DWELL, place a No. 4 crosspoint screwdriver on drive shaft and turn drive shaft counterclockwise to move bolt position indicator forward to SEAR.
- 7.2.10 Fire main gun. If main gun fires, end troubleshooting. If main gun fails to fire, notify organizational maintenance.

7.3 PERFORM M242 MAIN GUN MISFIRE PROCEDURE (COOL GUN).

**NOTE**

Main gun is considered cool if less than 50 rounds have been fired in last five minutes.

**WARNING**

Accidental firing of main gun could result in death or injury. Ensure that main gun is aimed in a safe direction and that no personnel or equipment are in line of fire.

- 7.3.1 If first round, ensure M242 safety is in FIRE (inline).  
7.3.2 Wait five seconds. Press misfire reset warning indicator.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
X	X

- 7.3.3 Close palm switch and squeeze trigger on gunner's hand control. Gun should fire. If not go to 7.3.4.
- 7.3.4 Set WEAPON ARM switch to SAFE.
- 7.3.5 Place M242 safety to SAFE (crosswise).
- 7.3.6 Set WEAPON ARM switch to ARM.
- 7.3.7 Press MISFIRE RESET WARNING INDICATOR.
- 7.3.8 Position Gunner's 200/100/SS switch to SS.
- 7.3.9 Place M242 safety to FIRE (inline).
- 7.3.10 Close palm switch and squeeze trigger on Gunner's Hand Control.

NOTE

Bolt position indicator on main gun should cycle to SEAR and SEAR indicator on CDU should light. If conditions are obtained, proceed to step 7.3.13. If conditions are not obtained, perform steps 7.3.11 or 7.3.12 as required.

- 7.3.11 If bolt position indicator has not cycled out of the MISFIRE position, proceed to IMMEDIATE ACTION TO CLEAR JAMMED MAIN GUN procedure.
- 7.3.12 If bolt position is at SEAR but SEAR indicator on CDU is not lit, press LAMP TEST switch up to ON.. If SEAR indicator lights, go to 7.3.13.

NOTE

If SEAR indicator does not light, replace bulb at first opportunity.

- 7.3.13 Close palm switch and squeeze trigger on Gunner's Hand Control.
- 7.3.13.1 If main gun fires, gun is operational. Go to 7.3.14.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
X	
X	
X	
	X



7.3.14 Reset Gunner's 200/100/SS switch to desired setting and continue mission.

7.4 PERFORM M242 MAIN GUN MISFIRE PROCEDURE (HOT GUN).  
Main gun is considered hot if more than 100 rounds have been fired  
in last fifteen minutes.

**WARNING**

Accidental firing of main gun could result in death or injury. Ensure that main gun is aimed in a safe direction and that no personnel or equipment are in line of fire.

- 7.4.1 Set WEAPON ARM switch to SAFE.
- 7.4.2 Place M242 safety to SAFE (crosswise).
- 7.4.3 Set WEAPON ARM switch to ARM.
- 7.4.4 Position Gunner's 200/100/SS switch to SS.
- 7.4.5 Set main gun manual safety to FIRE (inline).
- 7.4.6 Close palm switch and squeeze trigger on Gunner's Hand Control.

### NOTE

**Bolt position indicator on main gun should cycle to SEAR and SEAR indicator on CDU should light. If conditions are obtained, proceed to step 7.4.9. If conditions are not obtained, perform steps 7.4.7 or 7.4.8 as required.**

[illegible]

- 7.4.7 If bolt position indicator has not cycled out of MISFIRE, WARN ALL PERSONNEL OF A COOKOFF DANGER. All personnel shall remain clear of gun barrel for thirty minutes or until round cooks off, whichever occurs first. Proceed then to step 7.4.10.
- 7.4.8 If bolt position indicator cycles to MISFIRE, troubleshoot.
- 7.4.9 Close palm switch and squeeze trigger on Gunner's Hand Control.
- 7.4.9.1 If main gun fires, gun is operational. Go to 7.4.11.
- 7.4.9.2 If bolt position indicator cycles to MISFIRE, troubleshoot.
- 7.4.10 Cycle main gun to SEAR position as follows:
- 7.4.10.1 Open weapons enclosure bag.
- 7.4.10.2 Turn locking ring on power cable left and unplug cable.
- 7.4.10.3 Place M242 safety to SAFE (crosswise).
- 7.4.10.4 Insert handcrank into manual drive gear hub.

NOTE

Main gun cannot be cycled to SEAR position if it is jammed. If gun cannot be cycled to SEAR position, proceed to IMMEDIATE ACTION TO CLEAR JAMMED MAIN GUN procedure.

- 7.4.10.5 Press in and hold sear release link lever.
- 7.4.10.6 Turn handcrank counterclockwise. Let go of sear release link lever when bolt position indicator clears MISFIRE position.
- 7.4.10.7 When bolt position indicator reaches SEAR position, stop turning handcrank and remove it from manual drive gear hub.
- 7.4.10.8 Connect power cable to M242 and turn locking ring to the right to lock.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	
	X
	X
	X
	X
X	X
	X
	X
	X
	X
	X
	X
	X
	X
	X

		TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
7.4.11	Place M242 safety to FIRE (in line).		X
7.4.12	Position Gunner's 200/100/SS switch to desired setting and continue mission.		X
7.4.13	Troubleshoot cause of misfire at earliest opportunity.		X
7.5	PERFORM SAFETY PROCEDURES WHEN HOT M242 MAIN GUN FAILS TO FIRE AND BOLT POSITION INDICATOR IN POSITION OTHER THAN SEAR AND MISFIRE.		
WARNING			
Main gun is considered hot if more than 100 rounds have been fired in the past 15 minutes or 50 rounds in the past 5 minutes.			
7.5.1	Notify all persons aboard of cookoff danger.	X	
7.5.2	Notify driver to stop vehicle and set master switch to OFF.	X	
7.5.3	All personnel except Commander exit vehicle immediately	X	
7.5.4	Commander aim gun downrange.		X
7.5.5	Turn TURRET POWER, WEAPON POWER and AUXILIARY POWER circuit breakers to OFF.		X
7.5.6	Set Turret Drive Lock to LOCK. Exit vehicle.		X
7.5.7	Remain clear of vehicle for 30 minutes or until cookoff.	X	
7.5.8	After 30 minutes or cookoff troubleshoot main gun.	X	
7.6	PERFORM IMMEDIATE ACTION TO CLEAR JAMMED MAIN M242 GUN.		
WARNING			
Accidental firing of M242 could result in death or injury. Ensure that M242 is aimed in a safe direction and that no personnel or equipment is in line of fire.			
7.6.1	Tell driver to stop vehicle.	X	

- 7.6.2 Turn TURRET POWER and WEAPON POWER circuit breakers OFF.
- 7.6.3 Turn TURRET DRIVE LOCK to LOCK.
- 7.6.4 Set WPM ARM switch to SAFE.
- 7.6.5 Place M242 safety to SAFE (crosswise).
- 7.6.6 Turn locking ring on power cable to left and disconnect power cable.
- 7.6.7 Use manual elevation handcrank to raise gun to between 15° and 30° elevation.
- 7.6.8 Disconnect link chutes from main gun feeder as follows:
  - 7.6.8.1 Release latch on link chute and move chute away from feeder.
  - 7.6.8.2 Disconnect links in link chute from link coming out of feeder.
  - 7.6.8.3 Move link chute out of way so feeder can be removed.
- 7.6.9 Disconnect feed chutes from feeder.
- 7.6.10 Break ammo belts at feeder.
- 7.6.11 Press button in center of drive shaft knob and pull drive shaft knob down approximately three inches.
- 7.6.12 Press and hold feeder handle lock.
- 7.6.13 Rotate feeder handle up (away from gun).
- 7.6.14 Release feeder handle lock.
- 7.6.15 Slide feeder from main gun. If feeder will not slide out, locate jam and remove it. If jam cannot be safely removed, notify organizational maintenance.
- 7.6.16 Place main gun feeder on floor.
- 7.6.17 Remove jammed AP and HE rounds and links from main gun feeder as follows:
  - 7.6.17.1 Press feed select solenoid knob in.
  - 7.6.17.2 Press in and hold timer lift rod in center of worm nut shaft.
  - 7.6.17.3 Turn worm nut shaft counter clockwise and release timer lift rod. Continue turning worm nut shaft counter-clockwise until timer lift rod pops back out.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
X	
X	
X	
X	
	X
	X
	X
	X
	X
X	
	X
	X
	X
	X
	X
	X

- 7.6.17.4 Repeat substeps 7.6.17.2 through 7.6.17.3 until feeder is cleared of AP ammo.
- 7.6.17.5 Pull feed select solenoid knob out.
- 7.6.17.6 Repeat substeps 7.6.17.1 through 7.6.17.5 for HE ammo.
- 7.6.18 Inspect main gun feeder for damage. If feeder is not damaged, it may be reinstalled after receiver is cleared. If feeder is damaged, notify organizational maintenance.
- 7.6.19 Inspect receiver for jammed rounds. If there are no jammed rounds, proceed to step 7.6.23. If there are jammed rounds, proceed to step 7.6.20.
- 7.6.20 Remove jammed round from receiver assembly. If jammed round cannot be safely removed, notify organizational maintenance. If round is jammed in chamber and bolt is closed, proceed to step 7.6.21.
- 7.6.21 Unlock and retract bolt from chamber as follows:
  - 7.6.21.1 Place 12-inch adjustable wrench on square part of bolt shaft just behind bolt lugs.
  - 7.6.21.2 Press SEAR release solenoid.
  - 7.6.21.3 Turn bolt clockwise with wrench to unlock.
  - 7.6.21.4 Turn drive shaft, on bottom of receiver, counterclockwise to retract bolt from chamber. If bolt will not retract, notify organizational maintenance.
- 7.6.22 Remove jammed round from receiver. If jammed round cannot be safely removed from receiver, notify organizational maintenance.
- 7.6.23 Inspect receiver for damage. If receiver is undamaged, reinstall feeder per main gun feeder installation procedure. If receiver is damaged, notify organizational maintenance.
- 7.6.24 Reload main gun per HE and AP FEED SYSTEM LOADING procedures.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
X	
X	
X	
	X
	X
	X
	X
X	
X	
	X

7.7 STOP RUNAWAY M240 COAX.

WARNING

Runaway COAX can cause death or injury.  
Keep COAX pointed in a safe direction.

- 7.7.1 Set WEAPON ARM switch to SAFE. If COAX continues to fire, go to 7.7.2.
- 7.7.2 Point COAX in safe direction.
- 7.7.3 Tell driver to stop vehicle.
- 7.7.4 Turn TURRET POWER circuit breaker OFF.
- 7.7.5 Verify TURRET PWR indicator light OFF
- 7.7.6 Turn WEAPON POWER circuit breaker OFF.
- 7.7.7 Verify WEAPON PWR indicator OFF.
- 7.7.8 If COAX still fires after power OFF:
  - 7.7.8.1 Grab COAX charger handle, pull back and hold or
  - 7.7.8.2 Grab COAX ammo belt at ammo box, twist and hold or
  - 7.7.8.3 If near end of ammo belt let COAX fire until end of ammo.
- 7.7.9 Perform immediate action to clear COAX.
- 7.7.10 Unload COAX and notify organizational maintenance.

7.8 REDUCE COAX GUN FAILURE TO FIRE (HOT GUN).

WARNING

When COAX is hot, COOKOFF of live round can kill or injure. If immediate action cannot be completed within 1 minute exit turret for 30 minutes. COAX is considered HOT when 300 rounds have been fired in 3 minutes or less.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
X	
X	
	X
	X
	X
	X
	X
X	
X	
	X
	X

- 7.8.1 Set WEAPON ARM switch to safe.
- 7.8.2 Position COAX manual safety to S (safe).
- 7.8.3 Pull back firmly on charger handle to eject misfired shell and charge COAX.  
If COAX is hot and bolt does not lock in rear position, go to Step 7.8.5.
- 7.8.4 If misfired round is ejected and COAX gun charges, set manual safety to F (FIRE), set WEAPON ARM switch to ARM, and continue firing.
- 7.8.5 Notify all personnel aboard vehicle of COOKOFF danger.
- 7.8.6 Commander aim gun downrange.
- 7.8.7 Notify driver to stop vehicle and set vehicle master switch to OFF.
- 7.8.8 All personnel except commander exit vehicle immediately.
- 7.8.9 Commander sets TURRET POWER, WEAPON POWER, AUXILIARY POWER circuit breakers to OFF.
- 7.8.10 Set TURRET DRIVE LOCK to LOCK and exit vehicle.
- 7.8.11 After 30 minutes return to vehicle and perform COAX clearing procedure.

7.9 PERFORM M240 COAX MISFIRE PROCEDURE.

WARNING

COAX is considered hot if more than 100 rounds have been fired in two minutes. If COAX is hot, do not perform any of the following steps, but go to COAX FAILS TO FIRE (HOT GUN) Procedure.

- 7.9.1 Attempt to fire round by charging it and firing the COAX several times.
- 7.9.2 If COAX is still jammed, pull charger handle to rear to lock bolt back.
- 7.9.3 Place COAX manual safety to S (safe).

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
X	
X	
X	
X	
	X
	X
X	
	X
	X
	X

- 7.9.4 Push in latches and open cover assembly.
- 7.9.5 Remove ammo belt.
- 7.9.6 Raise feed tray.
- 7.9.7 Locate round in chamber.
- 7.9.8 Perform COAX removal procedure, remove jammed barrel and set aside.
- 7.9.9 Change barrel so COAX is ready to fire.
- 7.9.10 Perform COAX installation procedure.
- 7.9.11 Perform necessary COAX uploading procedure to reload COAX.
- 7.9.12 Place COAX manual safety to F (fire), and continue mission.
- 7.9.13 To remove stuck cartridge case from jammed barrel, perform following substeps:
  - 7.9.13.1 Lift case from chamber. Pry case rim with screwdriver if case is tight.
  - 7.9.13.2 If case cannot be pried loose, remove swab holder from cleaning rod, insert rod through muzzle of barrel and gently tap rod to dislodge case from barrel.
- 7.9.14 To remove ruptured cartridge case from jammed barrel, perform following substeps:
  - 7.9.14.1 Push ruptured cartridge extractor through ruptured case.
  - 7.9.14.2 Pull back on extractor handle to remove ruptured case from barrel.
- 7.9.15 To remove live round that was fed into a ruptured case from jammed barrel, perform following substeps:
  - 7.9.15.1 Perform substeps 7.9.12.1 and 7.9.12.2 to remove live round from ruptured case.
  - 7.9.15.2 Push ruptured cartridge case extractor through ruptured case.
  - 7.9.15.3 Pull back on extractor handle to remove ruptured case from barrel.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
X	
X	
	X
	X
X	
	X
X	
X	
X	
X	
X	
X	
X	
X	
X	



- 7.10 REDUCE M257 GRENADE LAUNCHER FAILURE TO LAUNCH.
- 7.10.1 Stay clear of the launcher barrel for at least 30 minutes. Keep the launcher pointed downrange.
- 7.10.2 After 30 minutes, follow the download procedure, store misfired grenade at safe distance from vehicle and notify organizational maintenance.
- 7.11 PERFORM EMERGENCY TURRET POWER-DOWN PROCEDURE.
- 7.11.1 Turn TURRET POWER circuit breaker OFF.
- 7.11.2 Turn WEAPON POWER circuit breaker OFF.
- 7.11.3 Turn vehicle MASTER switch OFF.
- 7.12 PERFORM LOW AMMO OVERRIDE PROCEDURE.

NOTE

If firing of the Main Gun or COAX is required and a LOW AMMO indicator is lit, perform 7.12.1.

- 7.12.1 To fire the selected low ammo, cycle the LOW AMMO OVERRIDE switch in the spring loaded ON position.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	
X	
	X
	X
	X
	X

## 8. PERFORM POST-OPERATING PROCEDURES

**8.1 PERFORM M242 MAIN GUN DOWNLOADING PROCEDURE.**

- 8.1.1 Turn TURRET POWER circuit breaker OFF.
- 8.1.2 Verify TURRET PWR indicator not lit.
- 8.1.3 Turn TURRET DRIVE LOCK to LOCK.
- 8.1.4 Turn WEAPON POWER circuit breaker OFF.
- 8.1.5 Verify WEAPON PWR indicator not lit.
- 8.1.6 Place M242 manual safety to SAFE (crosswise).
- 8.1.7 Verify WPN ARM switch on SAFE.
- 8.1.8 If unloading AP, pull out feed select solenoid. If unloading HE, push in feed select solenoid.
- 8.1.9 Pull and hold the ready box forwarder release lever.
- 8.1.10 Pull mushroom (feed chute stop) to release the ammo belt.
  - 8.1.10.1 If feeder is jammed, it may be necessary to break the ammo belt at the feeder by releasing the feed chute and pulling one round out of the belt.
  - 8.1.10.2 Ammo belt will normally slide down the feedchute. However, if it doesn't, it can be cranked down using the 14mm ratchet wrench on the feed sprocket extension turning it in opposite direction of arrow..
  - 8.1.10.3 Stow 14 mm ratchet wrench.
  - 8.1.10.4 Repeat Steps 8.1.8 through 8.1.10.
- 8.1.11 Release forwarder release lever.
- 8.1.12 There is one round in the feeder, which can be fired downrange or removed by removing the feeder and cycling it manually.

## 8.2 PERFORM M240 COAX DOWNLOADING PROCEDURE.

- 8.2.1 Turn TURRET POWER circuit breaker OFF.
- 8.2.2 Verify TURRET PWR indicator not lit.
- 8.2.3 Turn TURRET DRIVE LOCK to LOCK.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
	X
X	
	X
X	
X	X
X	
	X
	X
	X

# WARNING

Downloading procedures requires working from inside of vehicle through turret opening. To prevent injury to personnel or damage to equipment, ensure that TURRET POWER circuit breaker remains in OFF position and TURRET DRIVE LOCK remains at LOCK position while working through turret opening.

- 8.2.4 Turn WEAPON POWER circuit breaker OFF.
- 8.2.5 Verify WEAPON PWR indicator not lit.
- 8.2.6 Turn WPN ARM switch to SAFE.
- 8.2.7 Pull charging handle to rear to lock bolt back.
- 8.2.8 Place COAX manual safety to S (safe).
- 8.2.9 Push in latches and open cover assembly.
- 8.2.10 Remove lead end of ammo belt from feed tray.
- 8.2.11 Slide ammo belt back into feed chute.
- 8.2.12 Raise feed tray.
- 8.2.13 Look into chamber. If empty go to 8.2.14. If round in chamber perform COAX MISFIRE CLEARING procedure.
- 8.2.14 Lower feed tray.
- 8.2.15 Close cover.
- 8.2.16 Place COAX manual safety to F (fire).
- 8.2.17 Pull charging handle to rear, squeeze trigger, and ease bolt forward.
- 8.2.18 Remove ammo belt from feed chute and 7.62 ammo box.
- 8.3 PERFORM M257 GRENADE LAUNCHER DOWNLOADING PROCEDURE.
  - 8.3.1 Turn TURRET POWER circuit breaker OFF.
  - 8.3.2 Verify TURRET PWR indicator not lit.
  - 8.3.3 Turn TURRET DRIVE LOCK to LOCK position.
  - 8.3.4 Turn WEAPON POWER circuit breaker OFF.
  - 8.3.5 Verify WEAPON PWR indicator is not lit.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
X	
X	
X	
X	
X	
X	
X	
X	
X	
X	
	X
	X
	X
	X
	X
	X

- | <b>TRAINING<br/>REQUIRED</b> | <b>HANDS-ON<br/>TRAINING<br/>REQUIRED</b> |
|------------------------------|---|
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
| X                            |   |
| X                            |   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
|                              | X   |
| X                            |   |
| X                            |   |
| X                            |   |

Do not place any part of hands or body  
in front of launcher.

- 8.4 PERFORM TURRET POWER-DOWN PROCEDURE.
- 8.4.1 Turn WPN ARM switch to SAFE.
  - 8.4.2 Turn WEAPON POWER circuit breaker OFF.
  - 8.4.3 Verify WPN PWR indicator not lit.
  - 8.4.4 Verify VENT switch OFF.
  - 8.4.5 Position turret (guns forward at approximately +10° elevation).
  - 8.4.6 Turn TURRET POWER circuit breaker OFF.
  - 8.4.7 Verify TURRET PWR indicator not lit.
  - 8.4.8 Turn TURRET DRIVE LOCK to LOCK.
  - 8.4.9 Close Gunner's M36E1 sight shield.
  - 8.4.10 Close Commander's M36E1 sight shield.
  - 8.4.11 Turn intercom off.
  - 8.4.12 Turn all radios off.
  - 8.4.13 Verify Gunner's and Commander's nightsight RETICLE Brightness Control OFF
  - 8.4.14 Verify Gunner's and Commander's nightsight power switches OFF
  - 8.4.15 Turn AUXILIARY POWER circuit breaker OFF.
  - 8.4.16 Verify AUX PWR indicator not lit
  - 8.4.17 Turn vehicle MASTER switch off.
  - 8.4.18 If required, close and lock Gunner's hatch.
  - 8.4.19 If required, close and lock Commander's hatch.

### 8.5 PERFORM POST MISSION CHECKLIST PROCEDURE.

[illegible]

8.6 MAINTAIN WEAPONS RECORD DATA/GUN BOOK ON M240/M242/M257  
ITS - TBD

8.7 MAINTAIN VEHICLE LOGBOOKS  
ITS - TBD

8.8 INITIATE VEHICLE WORK ORDERS  
ITS - TBD

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED

[illegible]

- 9.1.1 Feeder Assembly - Clean, inspect and lubricate.
  - 9.1.1.1 Perform feeder removal procedure.
  - 9.1.1.2 Perform feeder disassembly procedure.
  - 9.1.1.3 Wipe feeder with a clean rag dampened in LSA/CLP. Turn rotor to clean internal parts.
  - 9.1.1.4 Wipe feeder with clean dry rag.
  - 9.1.1.5 Rotate feeder handle to see if it locks and unlocks.
  - 9.1.1.6 Push Feed Select Solenoid to AP position and turn Worm Nut Shaft until it locks into position.
  - 9.1.1.7 Pull Feed Select Solenoid out to HE position and turn Worm Nut Shaft until it locks in position.

**NOTE**

While turning Worm Nut Shaft, observe for movement of feed sprocket, rotor, and Bolt Position Indicator.

**9.1.1.8 Lubricate Feeder Assembly.**

**NOTE**

**DO NOT LUBRICATE Feed Select Solenoid, electrical connectors, cables or Bolt Position Indicator.**

- 9.1.2 Receiver - Clean, inspect, lubricate.
  - 9.1.2.1 Perform Track and Bolt Removal Procedure.
  - 9.1.2.2 Clean heavy dirt from the receiver with soft brush.

<b>TRAINING REQUIRED</b>	<b>HANDS-ON TRAINING REQUIRED</b>
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X



9.1.3 Track and Bolt Assembly. Clean, inspect, lubricate.

WARNING

- o Solvent fumes can burn or poison.
- o Chain can move and injure fingers. Keep track assembly level, and keep fingers from between chain and sprockets.

- 9.1.3.1 Perform track and bolt disassembly procedure.
- 9.1.3.2 Using clean rag and cleaning solvent, clean bolt, bolt carrier, firing pin, firing pin sleeve, and track.
- 9.1.3.3 Check firing pin tip, spring, and firing pin tang. If any one of these is worn or broken, notify organizational maintenance.
- 9.1.3.4 Check track assembly for damage to chain drive sprockets, firing pin pawl, and safety pawl. If damage is found, notify organizational maintenance.
- 9.1.3.5 Check anvil for foreign objects. If object cannot be removed, notify organizational maintenance.

CAUTION

Grease on face of bolt causes dirt to collect in anvil which could cause main gun misfire.  
Do not lubricate face of bolt.

- 9.1.3.6 Put GMD on clean rag and lightly grease flat surfaces at both sides of track rails.
- 9.1.3.6 Lightly grease outside of bolt carrier.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X

- 9.1.3.7 Using clean rag, remove excess grease from flat surfaces at both sides of track rails and from outside of bolt carrier.

CAUTION

When temperature is below -25° F (-32° C), GMD grease can cause track rails, slider, master link, and chain to stick. When temperature is below -25° F (-32° C), use LAW lubricating oil instead of GMD grease on track rails, slider, master link, and chain.

NOTE

If temperature is above -25° F (-32° C), do step 9.1.3.9. If temperature is below -25° F (-32° C) do step 9.1.3.10.

- 9.1.3.9 If temperature is above -25° F (-32° C), use brush to put light coat of GMD grease on firing pin, firing pin sleeve, bolt body, cross slot, carrier track, and firing pin pawl.

- 9.1.3.10 If temperature is below -25° F (-32° C), use brush to put light coat of LAW lubricating oil on firing pin, firing pin sleeve, bolt body, cross slot, track rails, slider, master link, chain, and safety link.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X

CAUTION

When temperature is below -25° F (-32° C), GMD grease can cause bolt lugs to stick. When temperature is below -25° F (-32° C), use LAW lubricating oil on bolt lugs instead of GMD grease.

NOTE

If temperature is above -25° F (-32° C), do step 9.1.3.11. If temperature is below -25° F (-32° C), do step 9.1.3.12.

- 9.1.3.11 If temperature is above -25° F (-32° C), use brush to apply a heavy coat of GMD grease to bolt lugs.
- 9.1.3.12 If temperature is below -25° F (-32° C), use brush to apply a heavy coat of LAW lubricating oil to bolt lugs.
- 9.1.4 Barrel - Clean, inspect, lubricate.
  - 9.1.4.1 Use cleaning rod and swab with LSA/CLP to clean the barrel bore. Continue until the swabs come out clean.
  - 9.1.4.2 Inspect barrel for loose muzzle brake.
  - 9.1.4.3 Verify muzzle brake retaining pin in place.
  - 9.1.4.4 Sight through barrel from chamber end and verify barrel not bent.
  - 9.1.4.5 Verify barrel round count using weapon data book.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
	X

<b>TRAINING REQUIRED</b>	<b>HANDS-ON TRAINING REQUIRED</b>
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X

- 9.1.4.6 Visually inspect barrel bearings burrs and scars.
- 9.1.4.7 Use clean rags dampened with LSA/CLP and soft bristle brush to clean bearings.
- 9.1.4.8 Grease bearing with GMD using a brush.
- 9.1.4.9 Wipe down barrel with a light coat of LSA/CLP.

**CAUTION**

- 9.2.1 Perform M240 coax disassembly procedure.
- 9.2.2 Run a bore cleaning brush through bore to remove dirt or burned powder.
- 9.2.3 Run a swab soaked with LSA/CLP through bore until the bore is clean.
- 9.2.4 Use chamber brush, swabs, and LSA/CLP to clean gun chamber.
- 9.2.5 Check gas cylinder for carbon buildup. If gas cylinder has carbon buildup notify organizational maintenance.
- 9.2.6 Use swab and LSA/CLP with a receiver cleaning brush to remove powder fouling from the receiver.
- 9.2.7 Use clean, dry cloth to wipe buffer.
- 9.2.8 Move feed lever and cover labels to check spring tension.
- 9.2.9 Look for bent or worn parts.
- 9.2.10 Check flash suppressor for cracks, dents, tightness, burrs, and wear.

- 9.2.11 Check barrel adapter for cracks, dents, tightness, burrs, and wear.
- 9.2.12 Check barrel release lever for cracks, dents, tightness, burrs, and wear.
- 9.2.13 Pull charging handle to make sure charger assembly moves freely.
- 9.2.14 Look for bends, cracks, burred, or chipped rails.
- 9.2.15 Check for broken grips on trigger assembly.
- 9.2.16 Check assembly for bent cable guide on trigger assembly.
- 9.2.17 Check assembly for loose nut and bolt on trigger.
- 9.2.18 Check assembly for chipped or cracked trigger frame holding lug.
- 9.2.19 Check for loose or dirty solenoid.
- 9.2.20 Check trip lever and sear for damage, burns, cracks, chips, and wear.
- 9.2.21 Check cocking of the gun, move trip lever forward to see if sear lifted.
- 9.2.22 Position safety to S (safe).
- 9.2.23 Pull trigger, sear must not lower.
- 9.2.24 Position safety to F (fire).
- 9.2.25 Pull trigger, sear must lower.
- 9.2.26 Check operating rod, bolt, and drive spring for damage.
- 9.2.27 Press the roller to make sure it retracts.
- 9.2.28 Check electrical connectors for damage.
- 9.2.29 Check to be sure there are no bent prongs.
- 9.2.30 Lightly oil sliding parts by moving feed lever.
- 9.2.31 Lightly oil all rails.
- 9.2.32 Lightly oil the trip lever and sear surfaces.
- 9.2.33 Lightly oil roller post.
- 9.2.34 Lightly oil axis pins.
- 9.2.35 Lightly oil all polished parts of the piston extension.
- 9.2.36 Lightly oil primary extension ramps, feed roller surface, and driving spring.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X

**Do not oil top or face of bolt.**

- 9.3 PERFORM M257 GRENADE LAUNCHER PM.

- 9.3.1 Perform turret power-down procedure.
- 9.3.2 Remove rubber caps from grenade launcher tubes (if launcher tubes are loaded with smoke grenades perform grenade downloading procedure).
- 9.3.3 Verify launcher tubes are free of dirt and trash.
- 9.3.4 Clear drain hole at bottom of each launcher tube with probe or small piece of wire.
- 9.3.5 Clean inside of grenade launcher tube using M242 main gun bore brush and LSA/CLP.

Do not use gasoline, kerosene, hydraulic oil, benzene, benzol, or high pressure water, steam, or air for cleaning the M257.

- 9.3.6 Dry grenade launcher tubes with clean rags.
- 9.3.7 Verify firing contacts are clean and not damaged.
- 9.3.8 Verify grenade launcher tubes are not bent or dented.
- 9.3.9 Verify grenade launcher tubes are secure on turret armor plate.
- 9.3.10 Install rubber caps on grenade launcher tubes.

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		TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
9.4	PERFORM PM ON OPTICS.		
9.4.1	Remove M27 periscopes.	X	
9.4.2	Inspect periscopes for discoloration, interior moisture or cracks which could affect visibility. Report discrepancies to organizational maintenance.	X	
9.4.3	Inspect periscope mount rubber seals for cracks, nicks, or dryness. Replace as necessary.	X	
9.4.4	Replace M27 periscopes.	X	
9.4.5	Remove M36E1 day/night sights (gunner's and commander's).		X
9.4.6	Inspect day/night and night sight front lenses and rear lenses for dirt or moisture which could affect visibility. Report discrepancies to organizational maintenance.	X	
9.4.7	Wipe interior of M119 sight mount with dry rag.	X	
9.4.8	Install M36E1 day/night sight.	X	
9.4.9	Inspect <u>all</u> control knobs and collars on the M36E1 for smooth movement.	X	
9.4.10	Wipe clean all outside surfaces of the M36E1.		
9.4.11	Operate sight shield operating handle checking for smooth operation.	X	
9.4.12	Inspect sight shield housing spring for wear (stretching). Replace as necessary.	X	
9.5	PERFORM PM ON WIRING HARNESSSES.		
9.5.1	Check wiring harnesses for frayed wires and corroded, damaged, or disconnected connections. Report discrepancies to organizational maintenance.	X	
9.6	PERFORM PM ON HYDRAULIC SYSTEM.		
9.6.1	Check hydraulic fluid at sight gage. Gage should indicate full. Fill with MIL-H-46170 hydraulic fluid as necessary.		X
9.6.2	Check pop-up indicator on the hydraulic fluid filter assembly. If pop-up indicator is up, the filter should be replaced. Notify organizational maintenance.	X	

9.4.1 Remove M27 periscopes.

9.4.2 Inspect periscopes for discoloration, interior moisture or cracks which could affect visibility. Report discrepancies to organizational maintenance.

9.4.3 Inspect periscope mount rubber seals for cracks, nicks, or dryness. Replace as necessary.

9.4.4 Replace M27 periscopes.

9.4.5 Remove M36E1 day/night sights (gunner's and commander's).

9.4.6 Inspect daysight and nightsight front lenses and rear lenses for dirt or moisture which could affect visibility. Report discrepancies to organizational maintenance.

9.4.7 Wipe interior of M119 sight mount with dry rag.

9.4.8 Install M36E1 day/night sight.

9.4.9 Inspect all control knobs and collars on the M3621 for smooth movement.

9.4.10 Wipe clean all outside surfaces of the M36E1.

9.4.11 Operate sight shield operating handle checking for smooth operation.

9.4.12 Inspect sight shield housing spring for wear (stretching). Replace as necessary.

### 9.5 PERFORM PM ON WIRING HARNESSSES.

9.5.1 Check wiring harnesses for frayed wires and corroded, damaged, or disconnected connections. Report discrepancies to organizational maintenance.

## 9.6 PERFORM PM ON HYDRAULIC SYSTEM.

9.6.1 Check hydraulic fluid at sight gage. Gage should indicate full. Fill with MIL-H-46170 hydraulic fluid as necessary.

9.6.2 Check pop-up indicator on the hydraulic fluid filter assembly. If pop-up indicator is up, the filter should be replaced. Notify organizational maintenance.

- 9.6.3 Check hydraulic lines, connections and components for leaks. If leaks are found, notify organizational maintenance.
- 9.7 PERFORM PM ON FIRE CONTROL EQUIPMENT.
- 9.7.1 Position TURRET POWER circuit breaker to ON.
- 9.7.2 Hold the LAMP TEST switch in the ON position. All indicator lights should come on. Release switch.
- 9.7.3 Position Drive Select Lever UP (power mode).
- 9.7.4 Traverse and elevate using the gunner's and commander's hand controller checking for smooth operation.
- 9.7.5 Position TURRET POWER circuit breaker to OFF.
- 9.7.6 Position Drive Select Lever DOWN (manual mode).
- 9.7.7 Traverse and elevate using the elevation handcrank and the azimuth handwheel checking for smooth operation.

NOTE

Report discrepancies to organizational maintenance.

- 9.8 PERFORM PM ON DOMELIGHTS.
- 9.8.1 Turn domelights on and make sure they light in the white light, and in the blackout (blue/green light) modes.
- 9.8.2 Wipe domelights with clean dry rag.
- 9.9 PERFORM PM ON SEATS.
- 9.9.1 Inspect commander's and gunner's seats for rips, tears, holes, and open seams.
- 9.9.2 Make sure seatbelts are securely fastened to the seats.
- 9.9.3 Make sure seat adjustments work properly.
- 9.9.4 Lightly oil seat post.
- 9.9.5 Clean seat with stiff bristle brush.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
X	
	X
X	
	X
	X
	X
X	
	X
	X
	X
	X
	X
	X



9.10 PERFORM PM ON TURRET CREW STATIONS.

9.10.1 Check for trash and loose items underneath turret platform and around turret crew stations.

9.10.2 Make sure all controls and indicators are securely mounted.

CAUTION

Do not use gasoline, kerosene, hydraulic oil, benzene, benzol, or high pressure water, steam or air for cleaning the M257.

9.11 PERFORM PM ON WEAPONS ENCLOSURE BAG.

9.11.1 Check weapons enclosure bag zippers for dirt and damage.

NOTE

If weapon enclosure bag is torn, zippers do not move freely, notify organizational maintenance.

9.11.2 Wipe bag with clean damp rag.

9.12 PERFORM PM ON M242 MAIN GUN AP AND HE FEED CHUTES.

9.12.1 Check main gun AP and HE feed chutes for damage.

9.12.2 Check for bent or missing latches or latch pins on AP and HE feed chutes.

NOTE

If latches or latch pins are bent, and cannot be latched in place, notify organizational maintenance.

9.12.3 Wipe down AP and HE feed chutes with dry clean rag.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X

9.13 PERFORM PM ON M242 MAIN GUN AP AND HE LINK EJECTION CHUTES.

- 9.13.1 Visually check main gun AP and HE link ejection chutes for damage.
- 9.13.2 Visually check for bent or missing latches or latch pins on AP and HE link ejection chutes.

NOTE

If latches or latch pins are bent and cannot be latched in place, notify organizational maintenance.

- 9.13.3 Wipe down AP and HE link ejection chutes with dry clean rag.

9.14 PERFORM PM ON M240 COAX FEED CHUTE.

- 9.14.1 Check coax feed chute for damage.
- 9.14.2 Check for bent or missing latches or latch pins on coax feed chute.

NOTE

If latches or latch pins are broken or bent and feed chutes cannot be latched in place, notify organizational maintenance.

- 9.14.3 Wipe down feed chute with dry, clean rag.

9.15 PERFORM PM ON M240 COAX LINK EJECTION CHUTE.

- 9.15.1 Check coax link ejection chute for damage.
- 9.15.2 Check for bent or missing latches or latch pins on coax link chute.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X

NOTE

If latches or latch pins are broken or bent  
and link chute cannot be latched in place,  
notify organizational maintenance.

9.15.3 Wipe down link ejection chute with dry, clean rag.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X

### 10.1.1 Barrel

- WARNING**

10.1.1.2 Turn TURRET POWER circuit breaker switch OFF.

- WARNING**

10.1.1.8 Rotate barrel counterclockwise 1/4 revolution until it reaches a hard stop.

- WARNING**

### 10.1.2 Feeder

- 10.1.2.1 Position TURRET at 400 mils azimuth.

**WARNING**

Traversing with power requires alarm "TRAVERSING."

- 10.1.2.2 Turn TURRET POWER circuit breaker OFF.
- 10.1.2.3 Turn WEAPON POWER circuit breaker OFF.
- 10.1.2.4 Lock TURRET DRIVE LOCK to LOCK.
- 10.1.2.5 Unzip the weapons enclosure bag.
- 10.1.2.6 Place M242 manual safety on SAFE (crosswise).
- 10.1.2.7 Open Gunner's Sight Shield.
- 10.1.2.8 Disconnect AP and HE feed chutes from feeder.
- 10.1.2.9 Remove AP and HE link chutes.
- 10.1.2.10 Rotate drive shaft knob until bolt position indicator is in SEAR.
- 10.1.2.11 Press drive shaft button and pull drive shaft knob down approximately 3 inches.
- 10.1.2.12 Use manual elevation handcrank to position gun at approximately 15° elevation.
- 10.1.2.13 Press and rotate feeder handle up.

**WARNING**

Feeder may fall off receiver when feeder handle is rotated.

- 10.1.2.14 Slide feeder off receiver.

**WARNING**

Feeder weighs 54 pounds and may require two people to lift it.

<b>TRAINING REQUIRED</b>	<b>HANDS-ON TRAINING REQUIRED</b>
	X
	X
	X
	X
X	
X	
	X
	X
	X
	X
	X





CAUTION

Firing pin sleeve is small and can be lost.  
Handle firing pin sleeve keeper with care.

- 10.1.5.8 Pull firing pin assembly out of bolt.
- 10.1.5.9 Turn bolt carrier over and remove cam pin.
- 10.1.5.10 Remove bolt from bolt carrier.

10.2 PERFORM M242 MAIN GUN INSTALLATION PROCEDURE.

10.2.1 TRACK AND BOLT ASSEMBLY.

- 10.2.1.1 Slide bolt into bolt carrier with cam pin hole facing up.
- 10.2.1.2 Align cam pin hole with cam pin slot, and push cam pin into cam pin hole until it is fully seated in bolt.
- 10.2.1.3 Place bolt head on work surface with ejector off work surface.
- 10.2.1.4 Slide firing pin into bolt with firing pin tang facing rear.
- 10.2.1.5 Install firing pin sleeve over firing pin and into bolt.
- 10.2.1.6 Clean firing pin sleeve keeper with clean rag.

CAUTION

Firing pin sleeve keeper is small and can be lost.  
Handle firing pin sleeve key with care.

- 10.2.1.7 Insert and press firing pin sleeve keeper into hole in bolt.
- 10.2.1.8 Push down on rear of firing pin sleeve until firing pin sleeve keeper pops into hole.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X





Keep fingers from between sprocket and chain.  
Chain can move and injure fingers.

- 10.2.2.4 Hold forward left sprocket so chain will not move, and place track and bolt assembly in main gun receiver.
- 10.2.2.5 If chain sear is not between chain links, turn drive shaft knob until chain sear is between chain links.
- 10.2.2.6 Push and wiggle track and bolt assembly until it is seated in main gun receiver.
- 10.2.2.7 Push track latch handle toward receiver as far as it will go.
- 10.2.2.8 Turn drive shaft knob until bolt moves to rear and locks in sear position.
- 10.2.2.9 Press lock button in center of drive shaft knob, and push drive shaft knob in as far as it will go, then release lock button.
- 10.2.3 RECEIVER.
  - 10.2.3.1 Turn TURRET POWER and WEAPON POWER circuit breakers OFF.
  - 10.2.3.2 Position TURRET DRIVE LOCK to LOCK.
  - 10.2.3.3 Verify that gun mount is elevated approximately 15°.
  - 10.2.3.4 Clean and lightly lubricate gun mount.
  - 10.2.3.5 Rotate locking handle on gun mount towards center of turret.
  - 10.2.3.6 Place HE (lower) link chute in position on gun mount.
  - 10.2.3.7 Place weapon manual safety on SAFE (crosswise).
  - 10.2.3.8 Rotate receiver so that buffer is on left.

[illegible]

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
X	
X	
	X
X	
	X
	X
X	

#### 10.2.4 FEEDER.

- 10.2.3.9 Insert receiver into gun mount.
  - 10.2.3.10 Rotate receiver clockwise approximately 35°.
  - 10.2.3.11 Rotate locking handle on gun mount away from center of turret.
  - 10.2.3.12 Time the receiver (rotate drive shaft until the bolt is in SEAR position).
  - 10.2.3.13 Connect electrical connector.
- FEEDER.
- 10.2.4.1 Turn TURRET POWER circuit breaker OFF.
  - 10.2.4.2 Turn WEAPON POWER circuit breaker OFF.
  - 10.2.4.3 Position TURRET DRIVE LOCK to LOCK.
  - 10.2.4.4 Open Gunner's Sight Shield.
  - 10.2.4.5 Verify that gun mount is elevated approximately 15°.
  - 10.2.4.6 Press receiver drive shaft button and pull drive shaft knob down approximately 3 inches.
  - 10.2.4.7 Verify that the feeder has been timed.
  - 10.2.4.8 Press and hold feeder handle lock.
  - 10.2.4.9 Rotate feeder handle up and lock in place.
  - 10.2.4.10 Line up feeder with receiver guide rails and slide feeder forward until feeder handle lines up with receiver.

Feeder weighs 54 pounds and may require two people to lift it.

- 10.2.4.11 Press and hold feeder handle lock.**

- [illegible]

The AP feed chute is longer than the HE.

- 10.2.5 BARREL.
- 10.2.5.1 Rotate turret so that barrel is over front of vehicle.
  - 10.2.5.2 Turn TURRET POWER circuit breaker OFF.
  - 10.2.5.3 Turn WEAPON POWER circuit breaker OFF.
  - 10.2.5.4 Position TURRET DRIVE LOCK to LOCK.
  - 10.2.5.5 Locate ALIGN arrow stamped into barrel.
  - 10.2.5.6 Rotate barrel so that ALIGN arrow is on top.

Barrel weighs 89 pounds and will require two people to lift it.

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- 10.3.2.2.1 Position safety to S (safe).
- 10.3.2.2.2 Depress barrel locking latch and hold.

**WARNING**

Wear asbestos gloves if barrel is hot.

- 10.3.2.2.3 Turn barrel release to upright position.
- 10.3.2.2.4 Remove barrel.
- 10.3.2.3 Position manual safety to F (fire).
- 10.3.2.4 Pull charging handle to rear. Pull trigger and ease bolt forward.
- 10.3.2.5 Depress trigger pin spring and remove pin.  
Pull trigger and frame assembly down and back.  
Pull charging handle through cable guide.
- 10.3.2.6 Depress backplate latch.
- 10.3.2.7 Lift and remove backplate.
- 10.3.2.8 Press driving spring in, up, and out.

**CAUTION**

Do not stand behind driving spring during removal.

- 10.3.2.9 Raise cover assembly. Place left hand over backplate opening to catch operating rod and bolt assembly. Pull charging handle back, then pull operating rod and bolt assembly out.
- 10.3.2.10 Close cover. Push out cover hinge spring pin as far as possible with the back of buffer. Remove pin with fingers. Remove cover assembly and feed tray.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X



		TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
10.3.4.7	Slide COAX forward.	X	
10.3.4.8	Seat rear of COAX in cradle guide channel.	X	
10.3.4.9	Connect link chute.	X	
10.3.4.10	Install and lock gun-cradle securing pin.	X	
10.3.4.11	Connect feed chute.	X	
10.3.4.12	Place the charging handle in the weapons enclosure bag.	X	
NOTE			
Ensure charging cable is not in the way.			
10.3.4.13	Zip the weapons enclosure bag closed.	X	
10.3.5	M240 COAX rate of fire adjustment procedure.		
10.3.5.1	Perform COAX removal procedure.		
10.3.5.2	Perform COAX barrel removal procedure.		
10.3.5.3	Remove gas regulator collar from the gas port area.	X	
10.3.5.4	Remove gas regulator plug.		
10.3.5.5	The gas regulator plug will adjust to one of the three positions. Replace gas regulator plug so that the selected gas inlet hole on the regulator plug faces the barrel.	X	
10.3.5.6	Replace collar.	X	
10.3.5.7	Perform barrel installation procedure.		
10.3.5.8	Perform COAX installation procedure.		
10.4	PERFORM M36E1 SIGHT (GUNNER'S AND COMMANDER'S) REMOVAL/INSTALLATION PROCEDURES.		
10.4.1	Removal procedure.		
10.4.1.1	Turn AUXILIARY POWER circuit breaker OFF.		X
10.4.1.2	Verify AUXILIARY PWR indicator not lit.		X
10.4.1.3	Release expansion pin lock.		X



- 10.4.1.4 Rotate expansion pin 90° and remove.
- 10.4.1.5 Remove elevation linkage from elevation arm assembly.
- 10.4.1.6 Disconnect electrical connectors from sight head assembly.
- 10.4.1.7 Remove lamp housing from dovetail slot on sight head assembly.
- 10.4.1.8 Secure nightsight with hand to prevent it from falling.
- 10.4.1.9 Loosen front and rear latches to release nightsight elbow and remove nightsight elbow from sight head assembly.

CAUTION

Exposure of nightsight to sunlight or other bright light will damage image intensifier. Keep shield over objective opening until ready for use.

- 10.4.1.10 Secure daysight with hand to prevent it from falling.

NOTE

If removing gunner's sight, remove coax solid feed chute.

- 10.4.1.11 Disengage left and right latches to release daysight elbow and remove daysight elbow from sight head assembly.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X

CAUTION

Do not permit the elevation arm assembly to snap to a stop when removing sight. Serious damage to equipment may occur.

- 10.4.1.12 Loosen wing nuts and align vertically with slots.
- 10.4.1.13 Pull back on head rest assemblies to avoid interference with sight head assembly.
- 10.4.1.14 Secure sight head assembly with hand to prevent it from falling.
- 10.4.1.15 Release safety latch.
- 10.4.1.16 Remove sight head assembly from sight mounts.
- 10.4.1.17 Install day/night sight elbows into sight head assembly.
- 10.4.2 Installation procedure (gunner's and commander's).
  - 10.4.2.1 Disengage latches to remove day/night sight elbows from sight head assembly.
  - 10.4.2.2 Loosen wing nuts and position them vertically to align with slots in sight.
  - 10.4.2.3 Slide head assembly into sight mount. Seat properly. Safety latch should snap into place.

NOTE

Ensure that the latch is secure and that heads are properly mounted. Water seals will create resistance to seating.

- 10.4.2.4 Tighten wing nuts.
- 10.4.2.5 Slide daysight elbow into sight head assembly. Seat properly.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X

- | TRAINING<br>REQUIRED | HANDS-ON<br>TRAINING<br>REQUIRED |
|----------------------|----------------------------------|
|                      | X                                |
|                      | X                                |
|                      |                                  |
|                      | X                                |
|                      | X                                |
|                      | X                                |
|                      | X                                |
|                      | X                                |

Exposure of nightsight to sunlight or other bright light will damage image intensifier. Keep shield over objective opening until ready for use.

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11. PERFORM OPERATOR TROUBLESHOOTING PROCEDURES

11.1 TROUBLESHOOT M242 MAIN GUN FAILURE TO FIRE.

- 11.1.1 Verify safety is in FIRE (inline).
- 11.1.2 Verify WEAPON POWER circuit breaker is on.
- 11.1.3 Verify WEAPON PWR indicator is lit.
- 11.1.4 Verify WPN ARM switch is in ARM.
- 11.1.5 Verify MAIN GUN indicator lit.
- 11.1.6 Verify MAIN GUN connector and connector plugs are properly seated.
- 11.1.7 Verify SEAR indicator is lit. If not check bolt position indicator and perform appropriate immediate action.

11.2 TROUBLESHOOT M240 COAX FAILURE TO FIRE.

- 11.2.1 Verify manual safety switch in F (Fire).
- 11.2.2 Charge COAX.
- 11.2.3 Verify round in feed tray.
- 11.2.4 Verify WEAPON POWER circuit breaker ON.
- 11.2.5 Verify WEAPON PWR indicator lit.
- 11.2.6 Ensure WPN ARM switch is in ARM.
- 11.2.7 Verify COAX indicator lit.
- 11.2.8 Verify electrical connector is properly seated to the COAX solenoid.
- 11.2.9 Verify COAX is properly lubricated.
- 11.2.10 Check that ammo links are not binding in link chute.
- 11.2.11 Check that feed chute is latched in place at feeder tray and at coax solid feed chute. If necessary latch feed chutes in place.
- 11.2.12 Check to see if ammo is binding in box.
- 11.2.13 Check that feed chute has no binding ammo, broken ammo belt or separated ammo belt. If necessary remove and replace ammo in feed chute.

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
	X
X	
X	
X	
X	
X	



- 11.5.3 Turn drive shaft knob toward opposite direction of arrow on knob.
- 11.5.3.1 If drive shaft knob does not turn, bolt is locked in SEAR.
- 11.5.3.2 If drive shaft knob does turn, bolt is not locked in SEAR. Notify organizational maintenance.
- 11.6 TIME M242.
- 11.6.1 Time feeder.
  - 11.6.1.1 Perform feeder removal procedure.
  - 11.6.1.2 Place feeder on deck with worm nut shaft accessible to operator.
  - 11.6.1.3 Press in on timer lift rod and turn worm nut shaft counterclockwise. Release timer lift rod after one turn.
  - 11.6.1.4 Continue to turn worm nut shaft until bolt position indicator stops in SEAR position and timer lift rod pops out.
    - 11.6.1.4.1 If timer lift rod does not pop out or bolt position indicator does not stop in SEAR position, notify organizational maintenance.
- 11.6.2 Time receiver.
  - 11.6.2.1 Perform cycle M242 Bolt to Sear, Feeder Removal Procedure (11.5).

TRAINING REQUIRED	HANDS-ON TRAINING REQUIRED
	X
	X
X	
	X
	X
	X

**DATE**  
**FILME**